

THE IMPACT OF EDUCATIONAL TECHNOLOGY  
ON LEARNER INTERACTIONS:  
A MULTIPLE CASE STUDY OF ELEMENTARY CLASSROOMS

A Dissertation by

Russell K. Miller

Master of Education, Wichita State University, 1988

Bachelor of Music, Friends University, 1983

Submitted to the College of Education  
and the faculty of the Graduate School of  
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I have examined the final copy of this Dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirement for the degree of Doctor of Education with a major in Educational Leadership.

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Dr. Ian W. Gibson, Committee Chair

We have read this Dissertation and  
recommend its acceptance:

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Dr. Nancy Bolz, Committee Member

---

Dr. Jeri Carroll, Committee Member

---

Dr. Jean Patterson, Committee Member

---

Dr. Randy Turk, Committee Member

Accepted for the College of Education

---

Dr. Jon M. Engelhardt, Dean

Accepted for the Graduate School

---

Dr. Susan K. Kovar, Dean

## DEDICATION

To my wife, Susan, for her unconditional love, encouragement, and support – during my doctoral journey and, more importantly, throughout our life journey together.

The rate of change in the society in which we live forces us to  
redefine how we shall educate a new generation.

*Jerome S. Bruner*

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## ABSTRACT

The purpose of this research was to study a selection of elementary school classrooms during their normal instructional routines in order to observe, analyze, and describe the impact of educational technology on learner interactions. As a study grounded in the concepts of the qualitative research tradition, the research methods employed included observations, personal interviews of teachers, focus group interviews of students, and document review. The purposeful selection of teachers, who were disposed to distinctly different pedagogical practice and use of educational technology, provided a wide variety of experiences for the data collection process as the researcher interacted with the classroom occupants in the role of participant observer. The study was conducted by a researcher who was simultaneously serving as the school's principal, providing an additional focus as the potential conflict of researcher and supervisor roles was explored and analyzed.

The analysis and presentation of these three individual case studies provided a thorough description of the learning environments under study, and explored the different philosophies and pedagogical practices of the three teachers in addition to their level of comfort with incorporating educational technology into their classrooms. Findings indicated that educational technology, when incorporated into traditional teaching practice, resulted in little change in learner interactions but a discernable increase in student interest and motivation. When integrated into lesson presentations that were more constructivist in nature – e.g. student-centered or project-based – educational technology was observed to facilitate higher levels of communication and collaboration between students and teachers. Particularly of interest was a “students as teachers” model that

occurred frequently as students shared their knowledge and interests with others, often coupled with teachers allowing students to have more control of the learning process.

The findings of the study support the conclusions that integrating technology can positively impact the interactions of learners in elementary classrooms when used as a tool to support constructivist pedagogy. The conclusions also definitively speak to the powerful role of the individual teacher and how their daily instructional decisions are impacted by their personal philosophies, background, pedagogical preferences, and comfort with the technological tools at their disposal.



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## CHAPTER ONE

### Background and Rationale of the Study

The use of educational technology in schools as a means to improve student learning has received extensive attention over the past two decades. With the advent of the internet and a variety of software and hardware applications, school districts have predominantly focused on the acquisition of hardware and computer network infrastructure in the pursuit of educational technology goals (Anderson & Becker, 2001). Innovations over that time period have ranged from the first introduction of single computers for use in classrooms, to stand-alone computer labs with limited skill-based software, to school wide distributive networks of computers running prescriptive curriculum-driven software applications, to wide area networks featuring broadband internet access and streaming video (Parsad & Jones, 2005). A dramatic increase has been observed in the availability of computer technology, as the student to computer ratio (without internet access) has been reduced from 125:1 in 1983 (Panel on Educational Technology, 1997) to nearly 4:1 by 2003, with almost 100% of schools having internet access (Parsad & Jones, 2005). While access and availability to computer technologies has significantly increased in schools throughout the country, questions persist as to the actual impact these technologies are having in the planning and delivery of instruction as well as the perceived benefits to the learning process. The study described in this document was designed to discover research-based truths related to educational technology and its use in schools. Such discovery will serve to assist in understanding the impact technology is having on the way the inhabitants of school classrooms interact with one another as they go about the business of “schooling.”

The impact of educational technology has been met with much skepticism in recent years due to a lack of evidence that it has been effective in improving student learning and its perceived excessive cost (Cuban, 2001). Federal school technology initiatives alone, for example, increased from \$21 million in 1995 to \$729 million in 2001 (O'Dwyer, Russell, & Bebell, 2004a). Market Data Retrieval (2005) accentuated this trend in that, despite continually declining budgets, 70% of school districts across the nation anticipated technology spending to increase or remain unchanged in the 2006 fiscal year. The extensive expenditures on technology in schools have been accompanied by claims that technology's impact on education is significant (Software & Information Industry Association, 2000). This report, notably commissioned by the software industry and significantly questioned by critics as to its intent due to a potential conflict of interest, also found positive correlations in technology affecting student achievement, motivation, and self-concept. Critics have often questioned such claims when made by insiders of the hardware and software industries (Weiner, 2000).

Bloom (1996) stated that educators should use much care and skepticism as they travel along the "information super-toll road" (p. ¶ 1). Bloom also perceived comparisons to the current push for technology with other reforms of the past that have failed or had minimal impact, e.g. language labs and filmstrip viewers. Such criticisms have at times been so prevalent as to catch the attention of the mainstream media. The New York Times referred to the work of William Rukeyser, coordinator of Learning in the Real World, a nonprofit organization that often questions the value of technology in schools. Rukeyser suggested that it was "incumbent on educators and policy leaders to adopt a caveat emptor attitude. The bottom line on educational technology is that the jury is still

out and more objective, arm's length research is needed" (Weiner, 2000, ¶ 14). The federal government has echoed these concerns more recently, arguing that "federal investments in educational technology have demonstrated too little impact on academic achievement...the value of educational technology needs to be weighed alongside other efforts to improve education" (Trotter, 2005, ¶ 3). The result of this shift in federal policy and implementation of significant federal education legislation (No Child Left Behind Act of 2001, 2002) has been to focus educational technology efforts away from curriculum and technology integration and toward more advanced data management systems (Trotter, 2005).

Many researchers have attempted to respond to the call for additional research in proving the value of educational technology. For example, the utilization of computer technology in schools can be perceived along a continuum of technology use. Coley, Cradler, and Engel (1997) found that most technology implementations had been oriented to drill and practice forms of computer-assisted instruction (CAI), which had generally been found effective in producing gains in student achievement. Kosakowski (1998) echoed that students usually learned more content more rapidly in classes that used CAI in this manner. A study by the National Center for Educational Statistics (Smerdon et al., 2000) found that the most frequent usage of computers was word processing or creating spreadsheets, "followed by Internet research, practicing drills, and solving problems and analyzing data" (p. 9).

At the opposite end of the educational technology continuum, advanced forms of technology integration have allowed students to have more control over their own learning. These typically more cognitive applications can "engage students in authentic

tasks, often with other students, using computer network software and databases that are intended not only to improve subject matter learning, but to develop skills in cooperation, communication, and problem solving” (Coley et al., 1997, p. 36). Heath et al. (2000), found that teachers observed improved student work interest and habits, which resulted in control often being loosened in other areas as students were granted “greater autonomy in their work” (p. 77), while Pisapia, Coukos, and Knutson (2000) noted less lecture and presentation of more complex material as integration of educational technology increased.

More recent initiatives in schools have provided laptop or handheld computers for each and every student, with some schools allowing students to check out computers for use at home as well as at school. Rockman (2003) claimed that such programs have required teachers to significantly restructure how they teach, allowing a students as teachers model to develop as “many students thrive in an environment where they have skills and knowledge to share and to trade” (p. 26). Questions, however, have continued to surface regarding how well teachers are prepared to utilize the current and emerging technologies of the 21<sup>st</sup> Century.

Teacher knowledge and training is a critical component in the successful integration of technology in today’s classrooms. The Software and Information Industry Association (2000) found that educators are an essential element in the effectiveness of technology. Such effectiveness depends upon a match between learner characteristics and educators’ teaching goals and technology implementation decisions. Coley et al. (1997) found that the effectiveness of any technology implementation is directly connected to teacher preparedness, yet they claimed that “most teachers have not had suitable training

to prepare them to use technology in their teaching” (p. 42). Kleiman (2000) observed that the lack of training and support to fully integrate technology into the core of classroom instruction is so prevalent that computers tend to be used “around the edges of the class’s main work” (¶ 7). Dirksen and Tharp (2000) also found that integration of educational technology has been primarily limited to “using technology as a resource tool” (p. 6).

The concern regarding teacher preparation for the effective utilization of educational technology was reinforced by Cuban (1996), who posited that the technological revolution in schools has been typically limited to a small cadre of determined users while the majority of teachers remained casual or nonusers of the available technologies. Cuban also proposed that teachers have lacked the access, skills, and knowledge necessary to properly utilize such technology effectively in classrooms. The preparedness of teachers to utilize technology was additionally addressed by Ivers (2002), who found although most teachers have rated themselves as intermediate users, they have not felt confident in using technology as a tool for student work. Preparation to use technology was also a focus of a report issued by the Congress of the United States (1995), which found a “majority of teachers report feeling inadequately trained to use technology resources, particularly computer-based technologies” (p. 3).

As schools have continued to embrace and expand their use of educational technology, teachers have often grappled with a lack of training in how best to integrate technology into their pedagogical practice (Moursund & Bielefeldt, 1999), while acknowledging that the use of technology has provided students “considerable motivation to work and engage in learning” (Lockwood, 1998, p. 12). A movement toward more

constructivist-oriented teaching and learning has been observed to incorporate technology in more powerful ways (Ravitz, Becker, & Wong, 2000). This has been observed to result in students who are “more active, autonomous, and highly engaged” (Heath et al., 2000, p. 34) as learners of all ages interact with one another at the intersection of educational technology and pedagogical practice (Gibson, 2001).

In light of these varying perspectives, there is a need to emphasize the role of research-based evidence of the impact of educational technology on teaching practice and the interactions of classroom inhabitants. Such evidence will serve to guide future practice as well as future pedagogical and technological resource decisions.

#### *Statement of the Problem*

The potential of educational technology to reform education is of primary interest to educators, local education agencies, and legislators throughout the nation. Billions of dollars are allocated for computer hardware, software, and teacher training annually, yet critics have continued to question whether this infusion of capital has had any real impact on teaching and learning. While research into the impact of educational technology on student achievement exists, the problem remains that there is not enough known about the impact of such technology on the learning environment of elementary school classrooms, particularly on how learners of all ages interact and react with one another when technology is integrated into the learning process. Technological innovations continue to advance and are resulting in significant societal changes; the *Digital Child* of today has “never known a time when computers were not an ordinary part of day-to-day life...or a time when it was difficult to access information or to communicate with other human beings with little regard to their actual geographical location” (Layton, 2000, ¶ 2).



Meanwhile, schools across the nation are struggling to enter the *Digital Age*, while most classrooms continue to operate in an *Industrial Age* model (The George Lucas Educational Foundation, 2002). In order to better lead schools into the Digital Age, school leaders, teachers, and teacher preparation programs can benefit from additional insight and knowledge into how the integration of technology is impacting learner interactions in the elementary school classroom learning environment. At present, there is insufficient focused research on this topic.

### *Purpose of the Study*

In an effort to embrace the potential of the Digital Age classroom (The George Lucas Educational Foundation, 2002) while using new technology tools and information-distribution techniques “to reach and excite young minds” (McHugh, 2005, p. 33), school personnel at the research site have continued to purchase and implement the use of a variety of educational technology applications intended to engage students and enhance teaching and learning. Most recently this investment has included the acquisition of a number of SMART Board interactive whiteboards, a wireless mobile laptop computer lab, and classroom sets of handheld computers to be utilized across the curriculum. While the desire exists to provide an excellent education for all students enhanced with the integration of technology into the curriculum, only a limited number of determined teachers fully embrace the vision of a Digital Age classroom. Such a vision is fueled by the strongly held belief among selected school personnel at the research site that a technologically rich school experience is necessary for students and schools in the 21<sup>st</sup> Century. It remains however, that while much is understood about best practices for integrating technology into the curriculum, greater understanding of its impact on the

interactions of learners of all ages is yet to be fully explored. The purpose of this study, therefore, was to observe, describe, and analyze the impact of educational technology on learner interactions in selected elementary school classrooms.

### *Research Question*

The following research question was developed to guide this study:

- What changes occur in interactions between learners in elementary classrooms due to the integration of technology into the learning environment?

The primary objective of this study was to observe a variety of elementary school classrooms and describe and analyze any patterns that existed in regard to how the use of educational technology was impacting learner interactions within the elementary classroom environment.

### *Significance of the Study*

This study sought to discover the impact of technology use on learner interactions in the context of a small, urban elementary school. Many facets of the research, therefore, were unique to this setting. Descriptive, scientifically derived data on the impact of technology on learner interactions in elementary school classrooms have been provided through this analysis, and as such have added to the knowledge base of how educational technology is affecting the learning environment of students and teachers. The research will thus support the process of transforming learning for students who exist in a technology-rich 21<sup>st</sup> Century society, and may also impact how universities and schools prepare new and experienced teachers for future learners and schools. Additionally, the research will contribute to the field of qualitative research through an exploration of the impact of potentially conflicting roles of the researcher on the researched.

### *Definition of Terms*

To assist the reader in better understanding this project, the following definitions are provided for key terms included in this report:

- Educational Technology – Newhouse, Trinidad, and Clarkson (2002a) defined educational technology as the “use of any technology to support the processes of teaching and learning” (p. 46). Specifically within this research context the term applied to desktop, laptop, and handheld computers along with peripherals designed to enhance the use of such technology (SMART Boards, printers, digital cameras, etc.).
- Learner – While this term could easily be limited to only students in classrooms, this research was undertaken with the concept that a classroom as a learning community consists of community members “expressing their aspirations, building their awareness, and developing their capabilities together” (Senge et al., 2000, p. 5), thus being inclusive of teachers and other adults as well.
- Interaction – In terms of technology and learners, the term interaction is often associated with distance education programs as well as the interactivity of computer hardware and software applications. Wagner (1994) stated that an instructional interaction is “an event that takes place between a learner and the learner’s environment...intended to change his or her behavior toward an educational goal” (p. 8), while Collins and Berge (2001) proposed two types of interaction related to learning: a student interacting individually with course content, and then interacting with others about the content. Attention to the

social component of human interactions was the primary focus of this research.

- Student-centered teaching – Often used interchangeably with “learner-centered teaching,” this concept is a critical component of constructivist teaching practice. This approach to teaching views students as active participants in their own learning and uses strategies where learning is more individualized than standardized, and such teaching practice assists students in developing higher-order reasoning and problem-solving skills (Integrating New Technologies Into the Methods of Education, 1999; Panel on Educational Technology, 1997).

#### *Methodology Overview*

In order to definitively answer the research question by investigating how technology was impacting the learning environment of elementary classrooms, a research design that allowed for direct observation and thorough exploration of the research context was necessary. Consequently, the design of the study, described in more detail later in this report, evolved from within the qualitative research tradition and is described as a multiple case study. Three separate classroom teachers were selected based upon their varied teaching styles, perceived level of technology integration, and openness to the research project. Such purposeful sampling (Patton, 2002) was based on the researcher’s observation and experience as a school-level administrator and the belief that selected participants would provide an open and trusting research environment for the study. A challenge in this study, and one explored in more depth later in the report, was that the “principal researcher” was also the “principal” of the study participants.

Four primary methods of data collection – observations, personal interviews, focus group interviews, and document review – were utilized during the research to provide a thorough understanding of the interactions between the learners in the selected classrooms. Throughout the data collection period the researcher conducted multiple informal observations in each classroom, acting in what has been called the participant observer role (Hall & Kassam, 1988; Spradley, 1980). During these informal observations the researcher freely interacted with the learners in the classrooms while jotting down salient points about the observation for later expansion into written fieldnotes (Bogdan & Biklen, 2003; Emerson, Fretz, & Shaw, 1995). Three formal observations were conducted in each classroom as well, with the researcher in a primarily observational role for a longer period of time. Again, notes were taken and elaborated upon for later reflection and data analysis.

Following the observations and nearing the end of the data collection period, personal interviews were held with each of the three teachers. Questions, developed prior to the research and expanded or revised following classroom observations, were asked in a conversational format intended to provoke an open-ended dialogue between the researcher and participant. A similar process was utilized with several focus group interviews of students. The student participants were selected due to their perceived ability to communicate effectively with the researcher, and questions similar to those asked of the teachers were utilized within the conversational interview.

The constant comparative method of data analysis (Lincoln & Guba, 1985) was used to look for similarities and differences between and among units of data collected from different sources. All data collected throughout the process (e.g. fieldnotes, observer

comments, interview transcripts) were unitized and coded to allow for the analysis of data. Common themes and categories surfaced throughout the research process, and once such labels emerged, each unit of data was coded according to where it fit within these categories. Each individual classroom was undertaken as a separate descriptive case study and, as such, is presented separately later in this document.

#### *Dissertation Format*

A synopsis of the background and rationale for this study has been presented in this chapter along with an overview of the methodology utilized in conducting the research. In order to better understand the research project and the academic and research work that has preceded it, a selection of related literature was reviewed to provide a foundation for this study and is presented in the following chapter. A thorough description of the research methodology is presented in chapter three. In order to fully explore the findings of the research, descriptive accounts of each case study are presented in the fourth chapter. Finally, the report concludes with a discussion of the case study findings and resultant conclusions, followed by an exploration of the implications of this research.

## CHAPTER TWO

### Literature Review

This review of relevant literature has been designed to provide a knowledge base of appropriate educational theory as well as an analysis of recent and past research in the field of educational technology upon which the study was built. The review begins with an exploration of the theoretical framework chosen to guide the study. Competing theoretical frameworks are also explored as an acknowledgment that other approaches or perspectives could have been used to frame the study. The next section of the review presents applicable research from two decades of technology use in schools, and features an overview of longitudinal studies as well as literature involving more recent laptop and handheld computer initiatives. Finally, literature is presented as a foundation for understanding the pedagogical beliefs and practices of teachers in general, and how the evolution of technology integration has been defined in classrooms over the course of the past twenty years.

#### *Constructivism Explored*

While defining the theoretical framework that guided this research process, the theory of *constructivism* continually emerged as the lens through which this study was to be viewed. The concept of constructivism is found consistently throughout educational research, and is becoming particularly more prevalent in current educational technology research as it enriches “students’ use of a variety of resources and help[s] them gain understanding about their world (Adams & Burns, ¶ 2). At the essence of constructivism is the belief that people learn through constructing their own understanding and knowledge, gained through their personal experience and reflection upon those

experiences. The role of the teacher in a constructivist classroom is transformed from one of purveyor of knowledge to a facilitator who guides children in the construction of their own knowledge (Adams & Burns, 1999).

While the roots of constructivist learning can be traced back to antiquity in the works of Socrates (Brooks, 2004), modern interpretations are based on the seminal works of prominent child development psychologists from the early to middle 20<sup>th</sup> Century. These foundational writings were explored to provide a thorough understanding of the cornerstones of constructivism, and are summarized in the following paragraphs.

In a departure from the behaviorist underpinnings of traditional education, John Dewey sought to describe how educators should understand the nature of how people think and process information. At the core of his theory was the concept of *reflective thinking*, which he described as “the kind of thinking that consists in turning a subject over in the mind and giving it serious and consecutive consideration” (Dewey, 1933, p. 3). In other words, accepting knowledge delivered by teachers at face value may not connect the new learning to any previous learning or experience, thus limiting the depth and application of understanding that comes with more reflective thought.

While Dewey (1933) insisted that learning new material and concepts was predominantly the responsibility of the learner, he also described the role of the teacher as one who must stimulate curiosity and fully engage students in the learning process as well as teach students how to think and process information:

The only way to increase the learning of pupils is to augment the quantity and quality of real teaching. Since learning is something that the pupil has to do himself and for himself, the initiative lies with the learner. The teacher is a guide



and director; he steers the boat, but the energy that propels it must come from those who are learning. The more a teacher is aware of the past experiences of students, of their hopes, desires, chief interests, the better will he understand the forces at work that need to be directed and utilized for the formation of reflective habits. (p. 36)

Dewey (1933) also elaborated on the process he described as the *recitation*. In traditional as well as constructivist classrooms this often takes place in teacher-guided questioning, although the traditional behaviorist classroom merely focuses on the rote learning of facts and memorization of simple answers. If utilized to its full extent, questioning leads learners to think reflectively and process information in such a way that “thinking is inquiry, investigation, turning over, probing or delving into, so as to find something new or to see what is already known in a different light” (p. 265).

Jean Piaget, a Swiss-born developmental psychologist, explored the role of cognitive development further. Piaget’s primary work centered around the cognitive development of children existing in stages that progressed one after another from birth through adolescence. The stages were presented by Piaget as the sensorimotor stage from birth to two years of age, the preoperational stage from two to seven years of age, the concrete operational stage from seven to twelve years of age, and the formal operational stage from age 12 through adulthood (Piaget, 1983).

Each stage of development was believed by Piaget to be sequential and necessary in order for the next stage to progress. The sensorimotor stage, the first of the four, existed completely prior to the development of language. The next stage, defined as preoperational, featured “language, symbolic play, mental images, and so forth, up until

about the age of seven – which permits the representation of thought” (Bringuier, 1980, pp. 25-26). The concrete operational stage was characterized by cognitive operations that applied “directly to objects and...defined as being internalized or internalizable and reversible” (p. 26), followed by the final formal operational stage that resulted from the capability to think in the abstract and be no longer dependent upon objects to understand and progress in cognitive development.

Additional exploration by Piaget focused on the two earlier developmental stages and was particularly interested in how imitation and the playing of games contributed to the cognitive development of children. Piaget posited that as children are presented with various schemas or experiences, they begin to assimilate that information into future events as they progress in their learning and begin to imitate themselves and others. Accommodation of these experiences occurs as a child applies previous learning and understanding to new experiences, and both assimilation and accommodation play a fundamental role in the development of a child’s intelligence (Piaget, 1962).

Lev Vygotsky, a Russian psychologist of the early 20th century, further expounded on the development of learning in children. While Vygotsky (1978) wrote extensively on the usage of signs and memory in the development of language, his cognitive theory known as the *zone of proximal development* in children is perhaps his most significant contribution to constructivist learning theory. In his laboratory work he found that intelligence tests typically used with children often discounted their potential for learning, focusing on their actual knowledge at a point in time; these tests were typically used to track children into specific schools and mental institutions of the day.

Vygotsky discovered that children of the same *chronological* age often learned at a different rate due to differences in their *mental* age. His zone of proximal development was thus defined as “the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers” (p. 86). Vygotsky’s theory, then, was that mental development often lagged behind physical development, and that the interaction with adults and peers in the learning process allowed new learning to be internalized and become a part of a child’s independent development.

Jerome Bruner, a prominent 20<sup>th</sup> century psychologist, was largely influenced by the earlier research on child development of Piaget and Vygotsky. He utilized the previously discussed stages of development in forming the theories presented in *The Process of Education* (Bruner, 1960), which had a profound impact on educators and policy makers of the day (Smith, 2002). Four major themes emerged in this work, which was a synopsis of learning and discovery that had taken place at a 1959 meeting of scientists, scholars, and educators at Woods Hole on Cape Cod, Massachusetts. The first theme, the role of structure in the learning process, was presented as a critical factor, and Bruner posited that the focus on mastering facts and techniques was “at the center of the classic problem of transfer” (Bruner, 1960, p. 12) of isolated skills to future learning. He found that in order for earlier learning to support later learning, “it must do so by providing a general picture in terms of which the relations between things encountered earlier and later are made as clear as possible” (p. 12).

The second theme, readiness for learning, purported that “any subject can be taught effectively in some intellectually honest form to any child at any stage of development” (Bruner, 1960, p. 33), and was critical of learning put off due to it appearing too difficult for younger students to comprehend. The concept of a *spiral curriculum* was introduced as a possibility to introduce a child at an early age to “the ideas and styles that in later life make an educated man” (p. 52).

A child’s readiness for learning was expanded in the third theme, which sought to encourage increased development of intuitive thinking along with the analytical approach of most educational experiences. Allowing children to guess or experiment while having the freedom of being incorrect was presented as an essential feature of productive thinking. Such an approach, however, “requires a sensitive teacher to distinguish an intuitive mistake – an interestingly wrong leap – from a stupid or ignorant mistake, and it requires a teacher who can give approval and correction simultaneously to the intuitive student” (Bruner, 1960, p. 68).

The final theme presented in this work was concerned with a child’s motives for learning, and proposed that the best stimulus for learning was interest in the material being presented as opposed to external modes of rewards and punishments. Bruner suggested that “motives for learning must be kept from going passive in an age of spectatorship, they must be based as much as possible upon the arousal of interest in what there is to be learned, and they must be kept broad and diverse in expression” (Bruner, 1960, p. 80).

Much of Bruner’s theory centered upon *discovery learning*, where students were encouraged to utilize the “natural energies that sustain spontaneous learning – curiosity, a

desire for competence, aspiration to emulate a model, and a deep-sensed commitment to the web of social reciprocity” (Bruner, 1966, p. 127). Such an approach to teaching and learning, while not requiring the student to discover everything on their own, would develop student competence as well as a confidence in operating independently, providing students with a “respect for their own powers of thinking, for their power to generate good questions, to come up with interesting informed guesses” (p. 96). Bruner proposed that inherent structural difficulties in schools, however, along with what was imposed upon the learner by the school, typically required a student to experience “restraint and immobility never asked of him before...he does not know whether he knows and can get no indication from anybody for minutes at a time as to whether he is on the right track” (p. 114). The role of teachers in developing intuitive and analytical students is to give students “as firm a grasp of a subject as we can, and to make him as autonomous and self-propelled a thinker as we can – one who will go along on his own after formal schooling has ended” (Bruner, 1961, p. 23).

Educational psychologist David Ausubel, active in his field in the 1950s to 1970s, developed his teaching and learning models based on the cognitive structures of children, which were very closely aligned with earlier psychological foundations. Ausubel proposed that for learning to have substance it must be meaningful in nature, and related to prior learning and cognitive processes. He introduced the theory of *subsumption*, proposing that since learning and knowledge are largely hierarchical in nature, each subsequent learning comes from the “subsumption of potentially meaningful propositions under more inclusive and general ideas in existing cognitive structure” (Ausubel, 1968, p. 52).

Ausubel differentiated between his *meaningful reception learning* theory and the use of rote or discovery learning. Although the latter practices could be potentially meaningful, rote learning was often cited as shallow knowledge prone to lapses of memory. Discovery learning, in its purest form, was seen as requiring too much time and too many resources as learners were left on their own to make meaning of a learning activity. He proposed an alternative instructional tool – labeled *advance organizer* – to assist students in relating new concepts to existing cognitive structures. An organizer is designed “whose relevance to the learning task is made explicit,” serving as a tool to assimilate newfound knowledge into the existing cognitive structure of the learner (Ausubel, 1968, p. 131). Ausubel proposed that organizers be designed for each new instructional unit to provide an ideational scaffold that would assist students in retaining and incorporating more detailed and differentiated material (p. 148).

In combination, the writings of Dewey, Piaget, Vygotsky, Bruner, and Ausubel serve to provide a deeper understanding of the theoretical framework of constructivism as the foundation upon which the ensuing analysis of the impact of technology on learner interactions is based. This exploration has provided pertinent knowledge of how, according to constructivist theorists, intellectual development in children occurs, and how, when presented with activities that naturally stimulate and engage the learner and are connected to previous learning, such pedagogical approaches can serve to strengthen learner interactions with academic content and with each other. The link between constructivist pedagogy and educational technology has been observed to result in significant changes in teaching and learning while often leading to more collaborative learning environments as students take more responsibility for their own learning

(Becker, Ravitz, & Wong, 1999; Ravitz et al., 2000). The merging of these theories thus provides an understanding of how learners interact with content and with one another while engaged in the process of learning. In order to more fully understand the underlying theoretical framework of this study, a short analysis of competing frameworks is presented and explored briefly in the following section.

### *Competing Theoretical Frameworks*

Whereas the concept of constructivism was selected as a lens from which to view the research process in this project, the accumulated data, and their analyses, other lenses might also have been utilized to frame the research question and subsequent research activities. In that the research question sought to determine changes in learner interactions due to the introduction of educational technology into the learning environment, two such competing frameworks for consideration could be grounded in the concepts of organizational culture and change, and systems thinking.

#### *Organizational Culture and Change.*

Organizational theorist Edgar Schein concluded that an organization's culture could be defined as "a pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration" (Schein, 1992, p. 12). Such cultural assumptions come to be "considered valid and...taught to new members as the correct way to perceive, think, and feel in relation to those problems" (p. 12). Schein proposed that these assumptions were primarily tacit – readily understood to members of the culture while yet unspoken and imperceptible to outsiders. Attempts to change the basic assumptions of an organization or culture (teaching methods, for example) are, according to Schein, "difficult, time consuming, and highly anxiety provoking" (pp. 26-

27). Sandholtz, Ringstaff, and Dwyer (1997), applied Schein's concepts to changes in schools while considering how teachers adopt new methods in order to effectively integrate technology into their teaching:

Teachers enter the profession with deeply held notions about how to conduct school – they teach as they were taught. If these beliefs are commonly held and help teachers negotiate the uncertainty of work in schools, no wonder teachers are reticent to adopt practices that have not stood the test of time. (p. 36)

Argyris (1999) presented additional insight in understanding organizational learning and cultures, and found that individual human beings hold two types of theories of action: “There is the one that they espouse. It is usually expressed in the form of stated beliefs and values. Then there is the theory that they actually use.” (p. 56) Whether considering change within industry or change within education, organizational leaders must be aware of these *espoused theories* and *theories-in-use*. New skills can be acquired and eventually become new theories-in-use, but often contain elements of the original behavior. Argyris maintained that the role of leadership in organizational learning was critical, for “in the final analysis, the subordinates’ learning will be reinforced or extinguished by the actions of their superiors. As both levels learn a new theory-in-use – hence can produce new actions – they necessarily also produce new learning systems” (p. 88).

The concepts presented in understanding organizational culture and change, e.g. basic assumptions and theories-in-use, could be applied to classroom decisions made by teachers as they plan for and deliver instruction. The utilization of educational technology



and perceived levels of implementation might serve to provide a critical perspective of teaching practices and beliefs of individual teachers.

### *Systems Thinking*

Senge (1994), defined *systems thinking* as a “conceptual framework, a body of knowledge and tools that has been developed...to make the full patterns clearer, and to help us see how to change them effectively” (p. 7). Examining events from a broad perspective in order to determine any observable patterns in seemingly unrelated events – examining an individual part in the context of the whole – can be a useful tool in examining how individual or isolated decisions may impact an organization.

Eight systems archetypes were proposed and described by Senge (1994), and were intended to assist in the identification and understanding of patterns in related events within an organization. The archetype presented as *limits to growth* could be utilized to investigate changes in the learning environment within this research due to the introduction of educational technology. Within the limits to growth archetype, the process of organizational growth or acceleration eventually slows and may indeed come to a stop due to a balancing process imposed by barriers to growth. Senge proposed that growth within the organization would continue only as the organization was successful in removing “the source of limitation” (Senge, 1994, p. 380).

The concept of *mental models* was also developed by Senge (1994) and Senge, et al. (2000). Mental models were defined as “our theories about the way the world works which influence our actions, which in turn influence the interactions of the system” (Senge et al., 2000, p. 83). Mental models impact how people interact with the world

around them, at times on an unconscious level, and Senge (1994) asserted that “mental models are active – they shape how we act” (p. 175).

The concept of systems thinking could be applied to organizations of all types, including schools. In that the current research was interested in changes in classroom interactions between learners, identification of any barriers to growth (e.g. lack of equipment or training) or mental models that impacted classroom decisions and behaviors (e.g. perceptions of what school should be like) would potentially contribute to a better understanding of the research setting.

Both of these bodies of theory – organizational culture and change, and systems thinking – predominantly focus on the impact of change on systems, e.g. a school culture or organizational structure. This research sought to investigate changes in learner interactions at the micro-level of learners in individual classrooms and as such would potentially benefit from a change theory perspective. In that the research sought to focus on changes in how learners interact during the teaching and learning process, however, a framework focused on teaching and learning theory provided a more thorough understanding of the research context.

#### *Constructivism as a Theoretical Framework*

Merriam (1998) proposed that the theoretical framework of a research project is “derived from the orientation or stance that you bring to your study...it is the lens through which you view the world” (p. 45). As the focus of this study was the impact of educational technology on learner interactions – particularly as a result of its integration into the teaching process – the framework of constructivism provided a knowledge base of a teaching and learning theory often associated with technology integration (Adams &

Burns, 1999; Ringstaff, Yocam, & Marsh, 1996; Sandholtz et al., 1997). Given the topic and intent of study, the concept of constructivism thus provided a natural framework that impacted all aspects of the research project – from literature explored, to research design, to behaviors observed, to questions asked in the interview process.

The research began with a straightforward question to explore: What changes occur in interactions between learners in elementary classrooms due to the integration of technology into the learning environment? In looking specifically at how students and teachers interact and react with one another and what changes, if any, occur in these interactions due to the integration of educational technology, the research began with two basic assumptions:

1. There are higher levels of student interaction and engagement in classrooms and lessons with a constructivist focus (Bruner, 1961; Piaget, 1983), and
2. Educational technology utilized in classrooms leads to more constructivist teaching and learning experiences (Ringstaff et al., 1996; Ross, Lowther, & Morrison, 2001; Wenglinsky, 1998).

The first portion of this literature review has focused directly on developing and supporting the theoretical framework. Inasmuch as the study sought to discover the impact of technology on learner interactions, the literature review proceeds with an investigation of the historical and current use of educational technology in schools, beginning with a review of several dated yet often cited studies.

#### *Longitudinal Studies*

Critics have suggested the possibility that computer use may negatively impact the social development of children (Shields & Behrman, 2000), and have maintained that

little research has been done to validate the impact of educational technology and whether the perceived anecdotal benefits outweigh the significant costs of technology in schools (Bloom, 1996; Cuban, 1997, 2001; Lockwood, 1998). Several major studies to the contrary are repeatedly cited within the literature, however, and a summary of those projects is presented in the following section.

*National Assessment of Educational Progress Study in Mathematics*

Wenglinsky (1998) conducted a research study of the 1996 National Assessment of Educational Progress (NAEP) mathematics results, consisting of national samples of fourth and eighth graders. The NAEP includes information on educational technology, including the frequency of computer use at school, access to computers and frequency of computer use in the home, professional development of mathematics teachers in computer use, and the kinds of instructional uses of computers by mathematics teachers and their students. Wenglinsky used a statistical analysis of the NAEP results using a technique of structural equation modeling; the study tested a model of how various technology characteristics might be related to various educational outcomes. The study found that “technology does matter to academic achievement, with the important caveat that whether it matters depends upon how it is used” (p. 32). Wenglinsky stated:

When computers are used to apply higher order concepts, and when teachers are proficient enough in computer use to direct students toward productive uses more generally, computers do seem to be associated with significant gains in mathematics achievement, as well as an improved social environment in the school. (p. 32)

It would appear from this research that teachers who utilize technology in a constructivist environment are more successful in improving student achievement through technology. Wenglinsky (1998) echoed this finding with a caution, stating that:

When technology is used properly, it can lead to gains in academic achievement and positively influence the social environment of the school, reducing teacher and student absenteeism and increasing morale. Yet it is important that the scope of technology in schools be limited to those areas where it provides benefits, and reduced in areas where it does not. Thus the notion of technology as a substitute for conventional forms of instruction, often hoped for by technology advocates and dreaded by technology critics, may overstate the case for technology use. (p. 34)

While the NAEP study was based on one particular evaluation of a national assessment, other studies were found in the literature that provided long-term evaluations of major technology initiatives. Descriptions of these studies begin with an exploration of a significant statewide initiative in the state of Idaho during the mid-1990s.

#### *Idaho Council for Technology in Learning*

The Idaho Council for Technology in Learning (ICTL) was charged by the Idaho State Legislature to evaluate the Idaho Technology Initiative of 1994, which provided for initial and ongoing monies for the purchase and integration of technology into the K-12 public school systems (ICTL, 1999). The ICTL developed statewide performance indicators to track progress and funds spent to achieve the indicators. The design of the plan used statewide tests, research studies, student surveys, and technology examples to measure the effectiveness of technology in the Idaho public schools. Goals evaluated by

the ICTL included technology integration, compatibility, teacher preparation, collaboration with communities and businesses, technology systems enhancing the efficient operation of Idaho schools, and training students to maintain technology.

This broad report looked specifically at the goals indicated above, and also investigated trends in various regions of the state and reported descriptive examples supporting regional and statewide assessments. In summary, the report found:

The benefits of technology in teaching and learning are clear: an increase in academic achievement in reading, mathematics, language and core studies, improved technology literacy, increased communication, well-trained, innovative teaching, positive relationships with the community, more efficient operation of schools, and technically qualified students ready to enter today's workforce.

(ICTL, p. 35)

The report further recommended that the legislature continue funding for the initiative for an additional five years, and that the ICTL continue to act as a governing body for Idaho school districts in collecting and reporting data, assisting districts in the refinement and expansion of technology integration, and maintaining accountability.

While the Idaho project and evaluation investigated a broad range of issues involving technology, another project begun in the early 1990s was more specifically focused on the acquisition and improvement of basic academic skills. This project in the state of West Virginia is presented in summary below.

#### *West Virginia Study*

Mann, Shakeshaft, Becker, and Kottkamp (1999) reported on an eight year study of the Basic Skills/Computer Education (BS/CE ) program that was authorized by the

state of West Virginia in 1989-90. The program provided every elementary school with enough computer equipment to serve a grade cohort of students each year with three or four computers, a printer, and a school-wide, networked server. The implementation began with kindergarten students in 1990-91, and the next grade level was added each year thereafter. The program also included intensive professional development and software chosen from one or two vendors. Schools could choose which vendor and whether to utilize a lab or distributed configuration.

The study found that “the initiative helped all children perform better, but the data indicate that BS/CE helped the neediest children the most.” This study then added that “children without computers at home made the biggest gains in (1) total basic skills, (2) total language, (3) language expression, (4) total reading, (5) reading comprehension, and (6) vocabulary” (p. 13) when provided access to these resources during the school day. Also of interest was that students who had access to BS/CE computers in their classrooms did significantly better than students who were taught with BS/CE equipment in lab settings. Mann et al. (1999) posited that “part of the explanation for BS/CE’s success is the defined focus of its implementation” (p. 14).

Due to the age of these studies and continual evolution of instructional technology, the primary focus of the aforementioned research was on technology programs grounded in Computer-Assisted Instruction (CAI), Computer-Based Instruction (CBI), and Integrated Learning Systems (ILS) formats. The scope of these forms of educational technology was primarily focused on using computers as a tutor, e.g. learning *from* technology (Ringstaff & Kelley, 2002), while additional studies followed a decided shift in technology integration. Such a shift in teaching practice included an evolutionary

process that moved toward a constructivist orientation while integrating educational technology.

*Apple Classrooms of Tomorrow*

Within the constraints of these systems, and primarily due to the birth of the internet, teachers began to experiment with more project-based, student-driven, and technology-rich instruction. The Apple Classrooms of Tomorrow (ACOT) initiative that began in 1986 served as a springboard to move away from drill-and-practice forms of CAI toward experimentation with a constructivist perspective. ACOT teachers reported “the changes they had instituted had a positive impact on their students, including increased engagement and motivation and improvements in students’ ability to work together” (Ringstaff, Yocam, & Marsh, 1996, p. 14).

Even within this high-profile project, the limitations of computer availability and access proved to be a challenge to all but the most proficient educational technologists. Not all teachers were successful in their efforts to change from traditional modes of teaching, at times abandoning the project altogether. Research findings and reflections on ACOT experiences found that teachers went through a number of developmental stages when attempting fundamental changes in pedagogy; traditional beliefs and practices were replaced as they progressed through these stages, and the research found that it was “critical that...working environments be supportive” (Dwyer, Ringstaff, & Sandholtz, 1990b, p. 8). These pioneering teachers envisioned a day when students would use and be responsible for mobile computers accessing the internet through a wireless network, along with large-screen multi-media capability infused into these classrooms of the future (Stuebing, Celsi, & Cousineau, 1994).



### *Laptop Computers*

The ACOT teachers' dream of mobile computing came of age with the advent of the laptop computer. As laptop programs have been implemented, schools have replaced aging desktop computers with laptops and sought to provide a computer for every student. At times this has been accomplished with a classroom set of laptops that could be shared between multiple classrooms in a school, while at other times a handful of laptops have been provided to multiple classrooms. The ultimate goal for technology advocates continues to be a 1:1 ratio of laptops to students as schools seek to move from students learning *from* technology to students learning *with* technology (Ringstaff & Kelley, 2002).

Several major studies of laptop computers were found in the literature. Rockman *ET AL* (1998) conducted an evaluation of four schools from across the nation participating in the "Anytime, Anywhere Learning" Program (AAL ) that was sponsored by the Microsoft Corporation. This research served to evaluate one of the pioneering attempts of one-to-one laptop computing in schools. In studying the potential for this level of access to dramatically impact constructivist learning and teaching, Rockman *ET AL* found:

Laptop students engage in more collaborative work. Their assignments provide them with frequent opportunities to locate, analyze, interpret and communicate information. They apply active learning strategies and critical thinking skills when completing school tasks and when considering real-world problems.

Teachers engage in less lecturing and spend more time consulting with students to facilitate independent learning. (p. 32)

The study also found that laptop students spent more time in school-related work outside of school, were more frequently engaged in classroom activities, were more often engaged in collaborative projects with other students, and spent a great deal more time using their laptops for the writing and editing process than any other application. Students were also reported to display higher quality presentation and communication skills. Teachers indicated that “the laptops encourage more problem-solving and critical thinking by students, in part because laptops provide students with a large number of choices that, in turn, demand advanced decision making skills” (Rockman *ET AL*, 1998, p. 48).

An additional study of the AAL program was conducted in a Michigan school district (Ross, Lowther, & Morrison, 2001). As opposed to the previously cited study’s focus on only one-to-one laptop learning, this evaluation sought to compare the classrooms that had 1:1 ratios (laptop students) to those classrooms where students shared laptops in a 5:1 ratio (computer-extended [CE] students). As in the case of the Rockman *ET AL* study, Ross et al. reported that teachers in laptop classrooms “increased their emphasis on higher-level learning in the classroom, project-based learning, or interactions with parents and students as a result of participating in the Laptop program” (p. 7). Although integration of subject areas was seen less frequently in laptop classrooms than in computer-extended classrooms, the use of technology as a tool for instruction was more frequently observed in laptop classrooms. Teachers in laptop classrooms also agreed that participation in the laptop program “increased students’ writing and reading skills...interest in learning, ability to work with other students, and...resulted in students having greater research skills, improved writing skills, greater interest in school, and

greater self-confidence” (pp. 7-8). The researchers concluded that while significant differences in student achievement were not observed between the two groups, there was “no question that the Laptop students were far superior to CE students in their computer skills and usage of technology for learning” (p. 11), and that “full access to computers in the classroom, whether or not there is access at home, is what drives curriculum and learning most substantively” (p. 12).

Russell, Bebell, and Higgins (2004) studied yet another variation on laptop implementation in their research of a Massachusetts school. Four classrooms were provided with permanent one-to-one laptop access, while five other classrooms shared a mobile laptop cart on a weekly rotating basis. In effect, all students had one-to-one access at some point, but the rotating classrooms would only have the opportunity every few weeks.

Russell et al. (2004) reaffirmed information gleaned from the previously cited studies. Students in one-to-one classrooms were more often observed working individually, and teachers reported that, although the laptop classrooms were larger, they were more able to individualize instruction for their students. The research concluded:

When full versus shared access to laptops is provided, technology use for a variety of academic purposes increases significantly. In addition, student engagement increases, the amount of time students spend writing increases, and classroom interactions between students and teachers change. (p. 14)

One-to-one laptop initiatives have continued to surface in recent years, often focused on entire school districts or even statewide projects. In the Henrico County Public Schools of Virginia, for example, 25,000 middle and high school students and

teachers received laptop computers as a part of a major technology initiative. An evaluation of this project by SRI International (Zucker & McGhee, 2005) reported that “the majority of teachers found the laptops to be especially helpful in affording them greater flexibility and versatility for professional and instructional purposes,” while students “reported that the laptop helped them manage and organize their work inside and outside of class” (p.26).

The Maine Learning Technology Initiative (MLTI) began in 2002, providing wireless laptop computers to seventh and eighth grade students and their teachers across the state. Silvernail and Lane (2004) reported that teachers perceived students with laptops “are more organized, they do more work, and that their understanding improves” (p. 21). Significant improvement was observed among at-risk students, as teachers cited that “attendance and behavior has improved, along with their motivation, engagement, and class participation” (p. 22). MLTI is reported to have had a significant impact on the learning environment as teachers reported using the laptops “a great deal in developing lesson plans, and in conducting research for lesson plans and instruction. Likewise, students use them to conduct research and complete class assignments” (p. 33).

The governor of New Hampshire proposed the Technology Promoting School Excellence (TPSE) program in 2003, which was directed at seventh grade students and teachers at six of the state’s neediest schools. Bebell (2005) found that “teachers quickly altered their existing practices in the 1:1 environment by increasing their use of technology for planning, research, preparation as well as communication, adapting lessons for special needs students, and general classroom instruction” (p. 18). The survey utilized for this research also concluded that teachers shared a “strong belief that the

TPSE program had positive impacts on teaching and learning for all types of students” and that “students of all ability levels demonstrated improvements in both working independently as well as collaboratively with their peers” (p. 33).

Evaluations of laptop initiatives continue to surface as more and more schools, districts, and states seek to provide one-to-one laptop computing to their students and teachers. Positive results are being reported on increased student achievement, attendance, motivation, and engagement (Jeroski, 2005; Laptops for Learning Task Force, 2004; Lemke & Martin, 2003, 2004a, 2004b, 2004c). Pitler, Flynn, and Gaddy (2004) have even proposed that one-to-one laptop initiatives are approaching a *tipping point* – where “the exception becomes the rule and a new technology becomes commonplace” (p. 6).

While research may support the infusion of laptop technology in schools with a goal of providing students anytime, anywhere access, the significant costs of computer hardware acquisition and maintenance continues to challenge schools across the nation (Rogers, 1999). The digital native of the 21<sup>st</sup> Century, however, will continually question how districts can afford *not* to fund such initiatives (Pitler et al., 2004, p. 6). Recent developments in handheld computing have resulted in devices with a standard operating system and markedly reduced costs as compared to laptop computers, providing a lower-cost alternative to schools and districts seeking to embrace the Digital Age.

#### *Laptop Word Processors and Handheld Computers*

One such device that emerged in the last decade was the AlphaSmart laptop word processor. While less advanced and incapable of most computer applications, the AlphaSmart was introduced as a word processor that would allow one-to-one

accessibility for students. In a study similar to the previously mentioned research, Russell, Bebell, Cowan, and Corbelli (2002) compared classrooms with one-to-one access to classrooms with shared resources in one Massachusetts elementary school. Russell et al. found that the 1:1 ratio of the word processors “led to changes in the way each teacher thought about and used technology with their class” (p. 18), and that students saw word processors as “a primary writing tool...having unfettered access to their own AlphaSmart also changed the way they approached writing and according to their teachers, nearly universally improved the quality of their work” (p. 19).

While the AlphaSmart’s capability was confined to word processing, the researchers found that the 1:1 ratio led to students increasing their use of laptop and desktop computers as well. The increased use of word processors assisted students in being more comfortable with other available technology. This in turn “decreased the amount of time teachers spent providing students with technical support...increased use of technology also led to an increase in peer conferencing and individual instruction as well as a decrease in whole group instruction” (Russell et al., 2002, p. 25). Changes in approaches to teaching and learning were thus impacted by a relatively limited technology that allowed the concept of electronic learning to develop.

Recently, the concept of electronic learning (e-learning) has been modified to become *mobile* learning (m-learning). Milrad (2003) suggested that handheld devices were emerging as one of the most “promising technologies for supporting learning and particularly collaborative learning scenarios. These technologies give the possibility to move away from the stand-alone computer, thus allowing interaction with several devices and making information accessible through a wireless connection to a server” (p. 2).

Milrad also posited that the potential of handheld computers to further advance constructivist teaching and learning in classrooms is profound, yet mobile and wireless technologies currently represent a low percentage of the technologies used in educational activities. Research of these applications is limited in the literature, but two major initiatives were identified and are discussed in the following paragraphs.

Pasnik, Hess, and Heinze (2001) evaluated a pilot program utilizing handheld computers (Compaq iPaks) and a software and network resource created by Mindsurf Networks. While the full pilot was limited to two schools in Maryland, an additional 86 schools across the country joined the study in a more limited fashion as *Schools of Innovation*. The handhelds were provided to ensure one-to-one access for students, and students in some schools were allowed to take the handhelds home after school. This around-the-clock access was determined to prove very significant, as “teachers whose students took the handheld computers home reported over 75 percent more types of formal classroom uses than those whose students kept the handheld computers at school” (p. 15). Such uses included completing homework assignments, collaborating on assignments, and e-reader activities, which were reported 50 to 100 percent more often in those classes with full-time access.

Attributes of educational technology mentioned previously, e.g. student engagement, motivation, etc., were observed in this research as well as the phenomenon of students and teachers learning new methods of learning and interacting with one another. An additional facet that has emerged with handheld computers is the ability to *beam* documents to other handheld users. The beaming application was found to significantly increase the amount of feedback teachers were able to provide to students

about their work product. Teachers also used the handhelds for formative assessment purposes as they guided the instructional process, and the majority of teachers reported that the handheld computer made “assessment and evaluation of student work more convenient, by allowing the teacher to carry student work in the handheld computer” (Pasnik et al., p. 18). The study also found that the Mindsurf software tools could enhance the constructivist teaching practice of inquiry-based learning while supporting more traditional pedagogy as well. Teachers participating in survey instruments indicated that the Mindsurf program assisted students in learning how to learn, and offered students “self-directed learning opportunities” (p. 23).

Additional research was conducted to evaluate the Palm Education Pioneers (PEP) Program, implemented in over 100 classrooms across the country (Vahey & Crawford, 2002). While the study examined a diversity of school sites, it admittedly took place with teachers who were forward thinking and technology-oriented. Many of the previously found advantages of technology-rich environments were duplicated in this study, with teachers consistently reporting high levels of student engagement and interest as the handheld computers were integrated into the instructional program.

Although PEP teachers from a wide range of curricular areas reported similar results, perhaps none were as enthusiastic about handheld computer applications as science teachers. Well over 90% of teachers surveyed reported that handheld computers dramatically improved the quality of learning activities in science classrooms. Vahey and Crawford (2003) postulated that such enthusiasm was “likely due to a number of factors, including the mobility of handheld computers, the availability of calculators and



spreadsheets for data analysis, and the availability of handheld computer peripherals, such as probes and sensors” (p. 10).

Higher levels of constructivist teaching methods were observed in many classrooms, particularly in open-ended writing tasks and inquiry-based science activities. It was noted that a number of traditional teachers found comfortable applications as well, notably the use of multiple-choice quizzes and flash cards. Additional benefits were observed in the teacher surveys, as teachers reported that the use of handheld computers in their classrooms provided a range of benefits for their students, including “increased access to and proficiency with technology as well as more complex and subtle impacts, such as increased self-directedness in learning and increased collaboration and cooperation” (Vahey & Crawford, 2002, p. 13).

Further evidence of a transition to constructivist pedagogy was found in students taking the initiative to develop ways to use handhelds for learning. Vahey and Crawford (2002) found that some teachers reported “allowing students to participate in developing the integration of handhelds enhanced the learning partnership between teachers and students...giving students a role in the integration of handheld technology gave teachers and students a greater sense of shared mission” (p. 28).

Research continues to grow and support the use of handheld computer technology in schools. Tatar, Roschelle, Vahey, and Penuel (2003), for example, proposed taking the concept of m-learning a step further, in that *classroom* learning (or c-learning) with handhelds is grounded in face-to-face participation, building on “constructivist learning paradigms that employ hands-on projects and cooperative learning groups” (p. 30). An additional study of the PEP project (van 't Hooft & Diaz, 2002) stated that “handhelds

were easy to use and enabled them to engage in a variety of projects involving data collection and analysis, writing, and sharing/collaborating through beaming” (p. 11), and Rudy (2003) discovered that handheld use “positively impacted teaching and learning as evidenced by changes in curricula, instructional planning, and student learning” (p. 3).

A dramatic increase in the availability and use of educational technology has been observed over the past two decades. Wireless networks, laptop computers, and handheld computers have definitively altered the landscape of 21<sup>st</sup> Century classrooms. As indicated in the previously cited studies however, a deciding factor in the productive use of such resources lies within the beliefs and practices of the individual classroom teacher.

#### *Teacher Beliefs and Practices*

From the beginnings of educational technology use in classrooms, a clear connection has been made between the successful use of technology and a teacher’s clear understanding of how such a tool fits into their own pedagogical beliefs and instructional practices. From the variety of technology applications found in today’s classrooms, the individual teacher’s “pedagogical beliefs and values play an important part in shaping technology-mediated learning opportunities” (Cox et al., 2003, p. 4). Successful implementation of technology is also more likely “when teachers are highly reflective about their own teaching practice and goals, in the sense that they consciously use technology in a manner consistent with their pedagogical beliefs” (Zhao, Pugh, Sheldon, & Byers, 2002, p. 492). Gibson (2000) made an argument for the transformational use of technology leading to the development of a *new* pedagogy of learning: while technology itself does not necessarily change the learning process, it can perhaps be a catalyst for change in educational contexts where “new perspectives, new thinking and new practice

are possible” (p. 51). Additional and more recent research has reinforced that an individual teacher’s belief about the positive impact of educational technology for students is the strongest predictor that a teacher will utilize technology in the delivery of instruction and in student use of technology for creating products during class time (O’Dwyer, Russell, & Bebell, 2004b).

Whether educational technology is utilized as an electronic worksheet or woven deeply into daily instruction, “the integration approach used by teachers depends on the teachers’ beliefs about the role of the computer in instruction, and the instructional objectives they attempt to meet through integration” (Pisapia et al., 2000, p. 29). As teachers move toward more integrated approaches of technology use, they are often challenged to change their core beliefs about teaching and instruction. Replacing the beliefs that govern teacher behavior thus “becomes critically important in changing educational practice in schools” (Sandholtz et al., 1997, p. 36). Teachers involved in the ACOT program, for example, were found to begin using technology primarily to supplement traditional instruction, but throughout the undertaking they began to “view learning as an active, creative, and socially interactive process” (Dwyer, Ringstaff, & Sandholtz, 1990a, p. 9). A decidedly constructivist bias developed during this decade-long project, while researchers noted the promising practices achieved during the change process grew slowly as innovative teachers dealt with structures where “cultural norms continue to support lecture-based instruction, subject-centered curriculum, and measurement-driven accountability” (Dwyer et al., 1990a, p. 2). Dwyer (1994) noted, however, that a transformation took place in the learning cultures of the ACOT classrooms as “teachers’ instructional beliefs and practices underwent an evolution” (p.

8), with teachers' personal use of the technology resulting in improvement in the competency of students.

The integration of educational technology has received extensive attention in the research to date, and researchers have found that a transformation in the culture of classrooms takes place only when technology is used “in a seamless manner to support and extend curriculum objectives and to engage students in meaningful learning...it is not something one does separately; it is part of the daily activities taking place in the classroom” (Dias, 1999, p. 11). In addition to becoming an integral part of a teacher's instructional toolkit, such transformations also find that “teachers are using technology more to support their own professional practice” (Martin, Kanaya, & Crichton, 2004, p. 25). The journey to a fully integrated approach is not an easy one, as many teachers have found that “integrating technology into the education systems and using it in ways that increase student learning and achievement are far more complex tasks than expected” (Lemke & Coughlin, 1998, p. 8).

Teacher comfort with and knowledge of computer hardware and applications has certainly had an impact on the ability to reach high levels of integration, although teachers with average computer skills – along with learning how to at times relinquish control to students – have been found “to integrate technology into their classrooms effectively because they recognized the importance of it as a tool for learning” (Heath et al., 2000, p. 78). The effective use and integration of technology has indeed been observed to occur in a number of stages as teachers have learned how to utilize the tools at their disposal (Dwyer et al., 1990b).

As teachers in the ACOT project participated in training and application of these tools, researchers consistently found that new patterns of teaching and learning were emerging throughout the ACOT sites. Through the identified stages of Entry, Adoption, Adaptation, Appropriation, and Invention, “text-based curriculum delivered in a lecture-recitation-seatwork mode [was] first strengthened through the use of technology and then gradually replaced by far more dynamic learning experiences for students” (Dwyer et al., 1990a). Progression through these stages was accentuated by a number of factors, including mentors who were further along in the process, opportunities for personal reflection, and encouragement for teachers to question their beliefs about teaching and learning (Apple Computer, 1995).

Additional studies have adapted the ACOT developmental continuum in their research. The Milken Family Foundation, for example, reduced the number of stages to Entry, Adaptation, and Transformation, which were based on the Adoption, Adaptation and Appropriation stages of the ACOT research (Coughlin & Lemke, 1999). Such modifications have found their way into the work of various organizations seeking to assist schools in planning for professional development that supports the strengthening of teachers’ educational technology integration. The state of North Dakota, for example, utilizes the Professional Competency Continuum (<http://pcc.hprtec.org/index.php3>), a tool based on the Milken research. The use of this instrument provides educators an opportunity to assess their technology integration knowledge and skill level while providing resources with which to plan for future learning. Advanced Learning Technologies (ALTec), a division of the University of Kansas Center for Research on Learning, developed and maintains the ProfilerPro online assessment tool

(<http://profilerpro.com>), again with the goal of supporting educators' self-assessment while also planning for and measuring the effects of professional development programs.

Other researchers have applied the concept of an integration continuum in understanding the impact of educational technology on schools in Western Australia (Newhouse, Trinidad, & Clarkson, 2002b). The five-stage continuum of Inaction, Investigation, Adaptation, Integration, and Transformation is not unlike the previously cited works, yet provides an additional concept. Newhouse et al. determined that between the third and fourth stages (Adaptation and Integration) lies a *critical use border*. At this point the researchers found that educational technology is utilized within constructivist learning environments and “exploited wherever possible...many learning experiences would either not be possible or be inadequately provided without the use of computers” (p. 9).

The process that occurs in the integration of educational technology has been observed to be difficult and challenging work. Researchers have repeatedly found that, in addition to having the appropriate tools at their disposal, teachers must also feel supported, free to take risks, and be provided with ongoing professional development opportunities to strengthen their skills (Coughlin & Lemke, 1999; Dwyer et al., 1990b; Newhouse et al., 2002b; Rogers, 1999; Zhao et al., 2002). The journey to full integration, then, is most likely evolutionary than revolutionary, and one where teachers will “experience more success and less frustration if they take small, but progressive steps toward change” (Zhao et al., 2002, p. 512).

The research outlined in this review of the literature served to provide a strong foundation of the theoretical framework of constructivism, an overview of over two

decades of research on the impact of educational technology in schools, and an exploration of the challenges inherent in adopting such technologies in today's classrooms. The use of educational technology in classrooms has evolved from an initial focus of learners interacting with specific computerized content (often disconnected from the remainder of an individual teacher's instructional design) to a deeply interwoven instructional tool capable of significantly extending instruction and providing opportunities for learners to critically interact with content and one another. The information gleaned from this review assisted in determining the direction of the research and provided a deeper understanding of the data collected during the research project. Additional research informed the methodological direction of the project, and is presented in the following chapter.

## CHAPTER THREE

### Research Design and Methodology

The literature reviewed in the previous chapter served to provide a foundation for this study and an understanding of educational technology and related issues. Additional literature informed the methodological choices for this research, and the specific research design is explored in detail in this chapter. The reported study took place within a single elementary school and sought to address the following research question: What changes occur in interactions between learners in elementary classrooms due to the integration of technology into the learning environment? In that the researcher sought to discover patterns in the interactions of learners in the elementary classroom environment, a logical choice for the research design chosen to guide this study came from the naturalistic research tradition, which allowed for the deep analysis of the phenomenon under study in the context of a natural environment. A qualitative orientation to this project allowed for such an approach through the collection of rich, in depth data, and through the opportunity to regularly interact with, while simultaneously studying, the members of the school culture. Working with and beside the participants throughout the data collection process provided the opportunity for exercising flexibility in the research design as the study evolved over the course of several months.

As opposed to quantitative research and its reliance upon predetermined evaluation instruments, Lincoln and Guba (1985) proposed that “naturalistic inquiry is always carried out, logically enough, in a natural setting, since context is so heavily implicated in meaning” (p. 187). The tradition of qualitative research relies on the researcher, or human instrument, to be the primary source of data collection. With a



culture under study often fluid and changing, inquiry “demands a human instrument, one fully adaptive to the indeterminate situation that will be encountered” (p. 187). The qualitative research tradition often guides the research designs of studies found in school settings, as the tradition allows the researcher to “enter and spend considerable time in schools, families, neighborhoods, and other locales learning about educational concerns...the data are collected on the premises and supplemented by the understanding that is gained by being on location” (Bogdan & Biklen, 2003, p. 4).

*Research Site*

The research site chosen for this study was a Kindergarten through 5<sup>th</sup> grade elementary school located in the central United States. The school district has become increasingly urban in recent years, with the number of minority and low-income students rising steadily. The research site, however, was located in a well-established, relatively affluent area of the district, and the school’s demographics were quite varied from the district averages, as noted below:

	District Average (2005-06)	Research Site (2005-06)
Caucasian	43%	70%
African American	22%	16%
Hispanic	21%	3%
American Indian	3%	2%
Asian	5%	1%
Multi-Racial	6%	8%
Low Income	67%	33%

Approximately 24% of the school's students ride the bus to and from school, and the school maintained over 96% student average daily attendance in 2004-05. The school employs 27.0 full time equivalent (FTE) certified and classified staff, with an average of 12 years experience; the school staff is predominantly female (88.9%) and Caucasian (92.6%).

The school enjoyed a rich relationship with technology for a number of years, and has continued to expand the presence of educational technology with SMART Board interactive whiteboards, digital video projectors, and additional desktop workstations for student and teacher use. The majority of desktop workstations were multi-media capable Windows-based personal computers running the Windows XP Professional operating system. A number of older workstations were utilized in classrooms as well, primarily for word processing and internet access.

The school was awarded a \$35,000 technology grant from the school district's Instructional Technology Department in the spring of 2004. The purpose of the grant was to provide classroom sets of handheld computers (a combination of Palm Tungsten E and Palm Zire 71 units) for students in first through fifth grade, other peripherals (probes, digital cameras, etc.) to supplement the school's existing hardware and educational technology program, and additional professional development for school staff members. Since winning the grant, the school has also acquired a mobile wireless Macintosh iBook laptop computer lab, allowing a 1:1 ratio of computers to students while the teacher is utilizing the resource. Training and implementation commenced during the 2004-05 school year and is ongoing as the school staff learns how to integrate these resources into daily curriculum and instructional practice.

### *Data Collection Strategies*

The reported qualitative research featured the concept of emergent design (Lincoln & Guba, 1985; Patton, 2002), which allowed the research to unfold naturally – guided along the way by the process of research and the researcher as human instrument. This emergent design was further explained by Creswell (2003), who noted that “aspects emerge during a qualitative study...research questions may change and be refined as the inquirer learns what to ask and to whom it should be asked” (p. 181). While the research question developed prior to the study commencing did not change, adjustments to the research process were made to respond to the emerging data. For example, the initial observation instrument was revised to better respond to the research context, and an exploration of the roles of teaching philosophy and pedagogy were not originally anticipated yet found to be critical in making meaning of the data.

In the search for meaning within the research context, the study began with the assumption that nothing was trivial, and that everything had the “potential of being a clue that might unlock a more comprehensive understanding” (Bogdan & Biklen, 2003, p. 5) of what was being studied. Strategies that supported discovery in this emergent design included observations of the natural setting, interviews of participants in the culture, and analysis of documents produced by the culture under study. Patton (2002) noted positive attributes within these methods, as “observations take place in real-world settings and people are interviewed with open-ended questions in places and under conditions that are comfortable for and familiar to them” (p. 39). The primary data collection methods of qualitative research selected to guide this study were observation of the research setting, personal interviews, focus group interviews, and document review. Observations of the

participants provided firsthand knowledge of the culture being studied while interviews provided an opportunity to discuss and more deeply explore the thoughts and perspectives of the participants while searching for a deeper understanding of interactions seen in prior observations. The review of pertinent documents provided further opportunity to better understand the adult participants in the study.

The research was conducted in a single elementary school in order to discover and better understand learner interactions in elementary classrooms and the impact of educational technology on those interactions. The researcher, who was concurrently serving as the school principal of the research site, selected a research design that followed a case study format, which Merriam (1998) stated was capable of gaining “an in-depth understanding of the situation and meaning for those involved” (p. 19). According to Merriam, the interest in case study research is in “process rather than outcomes, in context rather than a specific variable, in discovery rather than confirmation” (p. 19). As studying all classrooms within the school would have been beyond the scope of this study, the research was limited to three distinct classrooms within the school. Case study research allowed the delimitation of the object of study to specific persons, programs, and classrooms as the researcher gathered “as much information about the problem as possible with the intent of analyzing, interpreting, or theorizing about the phenomenon” (Merriam, 1998, p. 38).

As noted above, this case study was conducted in three separate classrooms in the same school. Yin (2003) referred to this format as a multiple-case design, and noted that a common example of the multiple-case study was “a study of school innovations...in which individual schools [or classrooms within a school] adopt some innovation” (p. 46).

The three classrooms were selected due to their perceived differences in teaching practice and technology integration, and thus were utilized to predict “contrasting results but for predictable reasons” (p. 47).

### *Research Participants*

Due to the timeframe of the research and scope of the research site, it was not possible to observe all classrooms or conduct interviews with all members of the culture. The researcher employed purposeful sampling to select classrooms and interview subjects. Subjects were selected with purposeful sampling based on their ability to offer a unique and informed perspective in regard to the phenomenon under study. Subjects of this type were described by Patton (2002) as being "information rich and illuminative," and as such offered “useful manifestations of the phenomenon of interest” (p. 40). Random sampling would have been appropriate if the goal of the research had been to generalize findings to a larger population. The study, however, sought to analyze the interactions of learners in the elementary classroom environment and the impact of educational technology on those interactions; deliberate and purposeful selection of classrooms and interview participants allowed the researcher to “learn a great deal about issues of central importance to the purpose of the inquiry” (Patton, 2002, p. 230).

The researcher served as a school principal for over fifteen years and as such was trained and experienced in the observation of classrooms, teachers, and students. In this role of expert observer, the researcher purposefully selected three classroom teachers who had been observed to have distinct teaching styles as well as displaying varying levels of comfort with and use of educational technology. The selected classrooms consisted of:

- A classroom led by a teacher using limited technology in the scope of a more traditional classroom setting;
- A classroom led by a teacher interested in and attempting to regularly incorporate technology into her teaching; and
- A classroom led by a teacher pursuing full integration and immersion of technology into instruction.

The classrooms were all intermediate classes housing students in 3<sup>rd</sup>, 4<sup>th</sup>, or 5<sup>th</sup> grade, and ranged in size from 19 to 27 students. More details of the student makeup of the individual classrooms are provided later in this report.

The research commenced with observations approximately one month into the school year, which consisted of informal, drop-in observations as well as formal, extended periods of observation. These observations assisted in identifying key participants for further data collection through personal interviews and focus group interviews. The purposeful selection of participants allowed for understanding the perceptions of the participants related to the research topic within the context of the study, and provided focused data directly related to the research question and purpose. All participants were required to sign an informed consent (or student assent/parental consent for minor participants) approved by the Wichita State University Institutional Review Board. Applicable consent forms submitted to the Board are included in the Appendices. Specific data collection strategies are explained in more detail below.

### *Observations*

The observation of interactions in elementary classrooms played a primary and salient role in the study. Observations allowed the opportunity to “notice things that [had]

become routine to the participants themselves “(Merriam, 1998, p. 95), and assisted in understanding the context of the culture under study. Data gained through observation assisted in understanding the classrooms and research topic “to an extent not entirely possible using only the insights of others obtained through interviews” (Patton, 2002, pp. 22-23). Initial fieldnotes during informal observations were recorded on a Palm T|X handheld computer using a FileMaker Mobile database, which included a number of drop-down menus for commonly observed phenomena in addition to a text field for the recording of short descriptions of salient observations. After synchronizing to a desktop computer version of FileMaker Pro, these “jottings” (Emerson et al., 1995, p. 20) were greatly expanded to include a complete description of the observation. The longer, formal observations were documented on a laptop computer using Microsoft Word, which allowed for more detail to be recorded as the observation was taking place. Fieldnotes were both descriptive and reflective in nature, and provided a written record of the sounds, sights, thoughts, and experiences observed during the course of “collecting and reflecting on the data” (Bogdan & Biklen, 2003, p. 110). Fieldnotes were also utilized to provide a thick description of the learning environments under study; observed interactions were described and included in the data analysis process, informing the establishment of themes and categories that guided the analysis. Observed behaviors and interactions also assisted in guiding the participant interviews that followed.

The researcher, as the instructional leader in the school under study, had consistently visited classrooms, interacted with students and teachers, and participated in classroom activities prior to the research project. While some observations of a formal nature consisted of little interaction with the research participants, most interactions

followed the *participant observer* tradition as the research commenced. Merriam (1998) found that the participant observer “sees things firsthand and uses his or her own knowledge and expertise in interpreting what is observed rather than relying upon once-removed accounts from interviews...observation makes it possible to record behavior as it is happening” (p. 96). Patton (2002) also noted that the primary purpose of observational data is to describe the setting, the people who participated in the setting, the activities that took place in the setting, and the meanings of what was observed from the perspectives of the participants. Observations served as a foundation for subsequent interviews with the research participants designed to understand the perspectives of the observed interactions.

The classroom research began with what Spradley (1980) called *grand tour* observations. Such observations allowed the researcher to observe and describe in detail the spaces, actors, and activities being studied, and assisted in providing a thick, rich description of the research site. The grand tour observations were supplemented with *mini-tour* observations that focused on a “much smaller unit of experience” (Spradley, p. 79). The observations assisted in understanding not only the social situation of the classrooms, but the culture as well, which Spradley described as “the patterns of behavior, artifacts, and knowledge that people have learned or created” (p. 86). Further observational data were gathered from a variety of observations. For example, informal observations occurred naturally as a result of the participant observer status of the researcher and were typically of shorter duration and unscheduled, while formal observations were prearranged and approximately 45 to 60 minutes in length.



To supplement and enhance the understanding of the research setting gained through participant observation, other methodological devices were needed to elicit additional information from the participants. Surveys or questionnaires, for example, could gather a great deal of information about public attitudes and orientation, and are typically useful in making generalizations from a sample to a larger population (Babbie, 2004; Creswell, 2003). The intent of this study, however, was to gain a clearer understanding of the research context with an exploration of the interactions of the research participants. For this purpose, interviews were utilized to supplement and extend the understanding of the classroom observations, and played a significant role in the study.

#### *Personal Interviews*

Interviews in qualitative research are utilized to “gather descriptive data in the subjects’ own words so that the researcher can develop insights on how subjects interpret some piece of the world” (Bogdan & Biklen, 2003, p. 94). The process of interviewing members of the culture under study helps to “understand and put into a larger context the interpersonal, social, and cultural aspects of the environment” (Erlandson, Harris, Skipper, & Allen, 1993, p. 85). Personal as well as focus group interviews allow the following of emerging lines of thought during the interview process and thus are not constrained just to the specific answers that would be included on a standard survey questionnaire. Consequently, interviews can assist in learning about the past, interpreting present conditions, and predicting future events through the eyes of the participant (Lincoln & Guba, 1985).

A combination of open-ended personal and group interviews therefore allowed a thorough understanding of the classrooms being observed. In seeking data that would answer the previously stated research question, the open-ended interview was structured in such a way as to allow such data to emerge naturally in a conversational format.

To assist in the interview process, a standard interview guide was developed. The process of using a standard, yet open-ended, interview guide provided “topics or subject areas within which the interviewer [was] free to explore, probe, and ask questions that [would] elucidate and illuminate that particular subject” (Patton, 2002, p. 342). The interview guide set a focus for the interview and provided a general direction, while the conversational format allowed for exploration of additional topics or themes that emerged during the interview. Whereas such conversations would result in a deeper understanding of the research site through the eyes of the interview subjects, personal interviews were conducted with the three classroom teachers selected for the study. Initial interviews provided an avenue to further explore the data gleaned from the classroom observations as the individual teachers described their philosophical orientation, teaching practice, and use of educational technology. Additional interviews were conducted following teacher review of the preliminary findings, which allowed for further clarification and extension of the data collected. The observation process assisted in identifying and refining the specific questions and probes to be utilized in the interview protocol, and the selected interview protocols are included in the Appendices.

#### *Focus Group Interviews*

An additional type of interview in qualitative research is the focus group, which is “structured to foster talk among the participants about particular issues” (Bogdan &

Biklen, 2003, p. 101). Such group interviews typically consist of 7-10 people, follow a standard, open-ended interview guide, and provide the opportunity for group members to discuss issues relevant to the research topic. In that focus groups were conducted with elementary school students, questions similar to those asked of teachers were included in the interview protocol and worded in such a way as to be “participant friendly” but of comparable design. The resultant discussions in the group interviews were “useful in bringing the researcher into the world of the subjects” (Bogdan & Biklen, p. 100), and were utilized “to get high-quality data in a social context where people can consider their own views in the context of the views of others” (Patton, 2002, p. 335). As members of a culture discuss a variety of topics, it is not unusual that their individual assumptions, misconceptions, and ideas may be challenged or reinforced (Krueger & King, 1998).

Participants for focus group interviews were selected through purposeful sampling and identified as members of the culture who were likely to share unique perspectives on the research topic. Each focus group consisted of a “relatively homogeneous group of people” (Patton, 2002, p. 335), and was conducted with selected students from each of the three classrooms. The focus groups included members of the Student Technology Leadership Team (STLT), a group of 4<sup>th</sup> and 5<sup>th</sup> grade students who assist in maintaining technology and assisting teachers in classrooms. STLT students applied for membership in this organization, and were required to have a minimum level of understanding and willingness to learn how to support the technology program through organization, inventory, and troubleshooting. As the “technology go-to” students in their classrooms, STLT students provided a unique perspective on the impact of technology on their interactions in the learning environment. Due to the relatively small size of the

school, each of the two older groups also included students who had been in one of the other classrooms observed during the previous year.

### *Document Review*

The review of salient documents can also assist the qualitative research process, as documents “of all types can help the researcher uncover meaning, develop understanding, and discover insights relevant to the research problem” (Merriam, 1998, p. 133). Documents can serve as “sources of rich descriptions of how the people who produced the materials think about their world” (Bogdan & Biklen, 2003, p. 124), as well as to provide “specific details to corroborate information from other sources” (Yin, 2003, p. 87). Documents selected for review included technology self-assessments completed by the teacher participants and teacher professional development portfolios.

Observations, personal and focus group interviews, and document review provided a wealth of data for review. In order to more thoroughly understand their relevance, all data collected throughout the study were submitted to detailed review and analysis.

### *Data Analysis*

Analysis of research data in a qualitative study is an ongoing process, one that occurs throughout the data collection period. Lincoln and Guba (1985) described the analysis process as “successive iterations of four elements: purposive sampling, inductive analysis of the data obtained from the sample, development of grounded theory based on the inductive analysis, and projection of next steps in a constantly emergent design” (pp. 187-188). As opposed to formulating theories prior to entering the research field, the development of grounded theory “emphasizes steps and procedures for connecting

induction and deduction through the constant comparative method, comparing research sites, doing theoretical sampling, and testing emergent concepts with additional fieldwork” (Patton, 2002, p. 125). The constant comparative method of data analysis allowed for the ongoing analyses of fieldnotes developed during observations and data gathered through personal and group interviews; emerging themes were identified throughout the data collection process and thus further guided the study (Bogdan & Biklen, 2003).

All observational fieldnotes, interviews, and focus groups were transcribed verbatim. These transcripts were then unitized, a process that separated the data into “single pieces of information that stand by themselves” (Lincoln & Guba, 1985, p. 203). Documents were reviewed in a similar method of content analysis, described as a “systematic procedure for describing the content of communications” (Merriam, 1998, p. 123), which attempted to “identify core consistencies and meanings” (Patton, 2002, p. 453) in the documents reviewed. Documents selected for review in this study included teacher self-assessments of technology skills and their professional development portfolio. Unitized data and salient information gleaned from the document review were then entered into a FileMaker Pro database, which allowed for coding each unit of data by categories that emerged during the research process; each categorized unit was then assigned to a theme that developed through the sorting of data. These themes and categories that emerged during data collection and subsequent analysis were then utilized to describe the findings of the study.

While the quantitative research tradition depends upon the elements of validity, reliability, and objectivity to ensure trustworthiness of the research, the qualitative

tradition provides “truth value through credibility, applicability through transferability, consistency through dependability, and neutrality through confirmability” (Erlandson et al., 1993, p. 132). The qualitative researcher strives to present his or her research in such a manner that the research findings are “worth paying attention to...worth taking account of” (Lincoln & Guba, 1985, p. 290), with specific measures employed to ensure that the results of the study are trustworthy. Lincoln and Guba (1985) explained that credibility is established through such methods as prolonged engagement and persistent observation, triangulation, peer debriefing, and member checking; transferability is established through thick description of the research; and dependability and confirmability are both established through the audit process.

Five primary methods were employed to ensure that the findings provided from this study were trustworthy:

- Member checks were conducted throughout the data collection process, which entailed “taking data and tentative interpretations back to the people from whom they were derived and asking them if the results are plausible” (Merriam, 1998, p. 204). Interview responses were confirmed with participants during and after the interview process. Observational fieldnotes were shared with teacher participants throughout the study to confirm researcher interpretation of observed interactions, and preliminary findings were shared with teacher participants for review and additional clarification if needed.
- Triangulation of the data occurred by comparing units of data from a variety of data sources. Erlandson et al. (1993) posited “data obtained directly from

the statements of individuals should be checked against observed behavior and various records and documents. Different questions, different sources, and different methods should be used to focus on equivalent sets of data” (p. 31). Participant interviews, observational fieldnotes, researcher reflections, and document content analysis all were utilized to confirm that emerging themes and categories were not singleton occurrences but indeed were established from a variety of sources.

- A thick, rich description of the research process and the culture under study has been provided in this research; such an effort sought to provide a “thorough description of the context or setting within which the inquiry took place and with which the inquiry was concerned” (Lincoln & Guba, 1985, p. 362). A description of this type thus “enables observers of other contexts to make tentative judgments about applicability of certain observations for their contexts” (Erlandson et al., 1993, p. 33). The transfer of the results of this study to other contexts, however, lies completely in the hands of the reader.
- A peer debriefer was utilized as a sounding board throughout the course of the research project to provide an “external check on the inquiry process” (Lincoln & Guba, 1985, p. 301). The technique of peer debriefing served to enhance the accuracy of the account by reviewing and asking questions about the study in order for it to “resonate with people other than the researcher” (Creswell, 2003, p. 196). The debriefer was well outside the context of the study but familiar with the topic and research process. He provided knowledgeable analysis of the materials and emerging design of the study,

listened to the researcher's rationale, concerns, and ideas, and shared pertinent feedback for refining the research process (Erlandson et al., 1993).

- Finally, the researcher utilized an external auditor to review the research and all its components to assist in ensuring the study's trustworthiness. Yin (2003) suggested that research should be conducted "as if someone were always looking over your shoulder" (p. 38), and documented in such a way that an auditor could arrive at the same results through repeating the research procedures. Data reported throughout the final report were cross-referenced with the raw data sources to ensure that no assertions were made without supporting data (Erlandson et al., 1993). The external auditor was charged with reviewing and critiquing the entire project (Creswell, 2003); the thorough description and supporting documentation of the project served to increase the probability of the study's overall trustworthiness (Lincoln & Guba, 1985).

A variety of data collection strategies were utilized throughout this research project, resulting in the findings, discussion, and conclusions that follow later in the report. Critical steps were taken throughout the process to assure that the study was trustworthy, resulting in a study with significant application in understanding the impact of technology on learner interactions in elementary school classrooms.

#### *Delimitations and Limitations*

Within the context of a research project, delimitations are used to "narrow the scope of a study" (Creswell, 2003, p. 148), and limitations are used within the research process to identify any possible or "potential limitations of the study" (p. 148).

Delimitations identified for this study included:



- The study was delimited to the timeframe, scope, and design of the research project.
- The study was delimited to the specific research site of a single elementary school and three specific classrooms within the site.

Additional factors were also identified as potential limitations to the study:

- The nature and scope of the research design and time constraints of the researcher did not allow a true and prolonged immersion in the classrooms under study. Patton (2002) stated that limitations can occur “in the situations (critical events or cases) that are sampled...from the time periods during which observations took place...[or the] selectivity in the people who were sampled either for observations or interviews” (p. 563).
- The researcher was the immediate supervisor of the research subjects, and as such the study may have been impacted by the subjects’ willingness to talk openly and honestly as a result of the supervisory relationship. This particular limitation is explored further in the following section.

#### *Researcher vs. Supervisor Role Conflict*

The qualitative research process often includes researcher immersion and involvement in the culture under study. As such participation has the potential for altering the culture at the same time the study is being conducted, researchers must be cognizant of this *observer (or Hawthorne) effect*. Bogdan and Biklen (2003) noted that qualitative researchers often try to “blend into the woodwork” (p. 35) and use such techniques as “modeling interviews after a conversation between two trusting parties rather than on a formal question-and-answer session between a researcher and a respondent” (p. 35).

Awareness of the observer effect, which can never be totally eliminated, can be used by the researcher to understand how their presence and participation impacts the setting and can also assist in the development of additional insights into the nature of the culture.

In that the principal researcher of this project was simultaneously the principal and thus supervisor of the research site, precautions and careful deliberation were demanded to offset potential conflicts that might result from this dual role. Anderson, Herr, and Nihlen (1994) noted that teachers often feel as if they are living in a fishbowl, where “their professional competence is constantly vulnerable to question from parents, students, principals, and fellow teachers...they are understandably defensive about what they may perceive as attacks on their professional competence” (p. 40). Additionally, a supervisor by nature is one who yields some authority or power, thus setting up a potential conflict that results from the perceptions or realities of power wielders who “are often causing and sustaining injustice and inequality” (Møller, 1998, p. 72). The researcher-supervisor, a male in a predominantly female setting, also had to be sensitive to gender and role relationships and the societal framework that “indicates the existence of a power differential and suggests the potential for bias in expectations and/or actions” (Paisley, 1994, p. 2).

As an insider who would continue to serve as a member of the culture under study long after the research was concluded, it was imperative that the researcher be aware of the impact of the research on the lives of those who were being studied (Zeni, 1998). The researcher was simultaneously supervising a school campus and conducting research on its inhabitants, thus being an *insider*, while at the same time searching for the objectivity of an *outsider* point of view. The line between these two roles, while clear to the

researcher, would often be blurred to the research participants. Thus, the researcher was continually cognizant that his colleagues would react to the “researcher hat” in much the same way as to the “supervisor hat” that they had become accustomed to in the researcher’s role as school principal (Anderson et al., 1994).

To ensure that the effects of any researcher-supervisor role conflict were kept to a minimum, a number of precautions were carefully established prior to the research commencing:

- Permission was obtained from the school district’s central administration to conduct the research.
- Approval was obtained from the researcher’s dissertation advisory committee and the University’s Institutional Review Board.
- An initial meeting with the teacher participants detailed the intent and purpose of the study, the proposed methodology, and their proposed roles in the study.
- Teacher participants were employees in good standing, licensed, and tenured.
- As tenured teachers in the district, annual personnel reviews were structured around personal and team goals tied to the school’s campus improvement plan. No traditional evaluation was required.
- Teacher participants were assured that, should any instance arise in their classrooms that would precipitate administrative intervention, the research would cease immediately and no research-based observations would be utilized for the basis of further evaluation.
- Conversations were held throughout the project to ensure that comfort with the research process continued, and

- Teacher participants signed informed consent forms prior to the researcher beginning the project.

The research was conducted in a manner that many educators have embraced as action research, often carried out by teachers within their own classrooms. The supervisory role of the researcher in this context, however, was openly acknowledged and confronted from the outset of the research design and implementation. Carpenter (1999) faced a similar hurdle in her research in a New Zealand school, and noted that her research was “neither fully objective nor fully neutral” (p. 9) while acknowledging that her biases, experience, friendships, and social construction would call her neutrality as a researcher into question. It is intended that the research being reported in this document, while contributing to the knowledge base of the impact of educational technology on learner interactions, will also serve to supplement the field of qualitative research and the impact of multiple roles of the researcher on the research context and findings.

The specific methods employed to design and conduct the research have been presented to allow the reader a thorough understanding of the study. Specific findings related to the data analysis of this qualitative study will be presented in the following chapter.

## CHAPTER FOUR

### Findings

As a research project grounded in the traditions of qualitative inquiry, this study was conducted following the methods described in the previous chapter. The primary methods of data collection included informal and formal observations in the classrooms, a personal interview with each teacher, and a focus group interview with selected students from each classroom. Data collected from these methods, in addition to pertinent documents gathered during the project, were analyzed by categorizing each unit of data that emerged during the analysis. The categories for analysis included Collaboration, Student to Teacher Interaction, Teacher to Student Interaction, Student to Student Interaction, Interaction with Technology, Interaction with Content, Interaction with People, Engagement/Motivation, Students as Teachers, Professional Development, Background, Philosophy, Pedagogy, Comfort with Technology, Researcher/Supervisor Conflict, Trust/Comfort, Students Changed during Observation, and Teacher Changed during Observation.

Following this categorization, the constant comparative method of data analysis was further utilized to identify any patterns in the data related to the interactions of learners within the classrooms and any impact the use of educational technology had on those interactions. Some categories resulted in few entries while others yielded significant amounts of data. Several themes emerged as the analysis continued, into which the categories naturally fell, assisting in the task of “sense making” and providing a basis upon which to thoroughly tell the research story. The themes that were developed and utilized as an outline for each case study included: Background, Philosophy and

Pedagogy (presented in the introductory paragraphs of each case study), Teacher Comfort with Educational Technology, Interactions in the Absence of Educational Technology, Interactions in the Presence of Educational Technology, Learner Perceptions of Educational Technology's Impact on Learning, and Exploring the Researcher-Supervisor Conflict.

The results of the analysis are presented in this chapter as individual descriptive case studies following the outline described above, and are presented in order of lowest to highest levels of technology adoption. Each case study begins with a thorough description of the classroom and background information on the teacher to assist the reader in understanding the research context. After presenting the findings related to technology and its impact on the interactions in the classroom, a description is provided regarding the researcher-supervisor role and any impact the dual role had on the inhabitants of the classrooms under study. While the comments of individual participants and researcher observations of participants are presented with names attached, pseudonyms were utilized throughout this report to protect participant confidentiality. Quotes followed by "O.C. MM/DD/YYYY" reflect an excerpt from the observation notes – an Observer's Comment – and are reflective commentary on a particular moment or event.

The research site was an elementary school that opened in 1930. The two-story structure features common elements of the era, including a red brick and limestone facade with intricate stonework flanking the large main entrances of the building. Sizeable expanses of windows span the exterior of the building, reaching nearly to the top of the 14-foot ceilings in each classroom. Several additions to the school over a period of

decades carefully mirrored the original structure in cosmetic appearance, resulting in a school that has grown from its original nine classrooms to seventeen classrooms, library, and multipurpose room.

The research described herein was conducted in three separate classrooms over the span of several months. Salient findings from each case study will be presented individually in a descriptive format, beginning with Anna's fourth grade classroom.

#### *Case Study #1 – Anna's Classroom*

Anna's classroom is found on the second floor of the structure, adjacent to the southern stair access to the second floor. The classroom is approximately 23 x 30 feet in dimension, with windows on the eastern wall that span the length of the room and begin from about four feet above the floor and reach nearly to the top of the high ceiling of the room. Two rows of fluorescent lighting fixtures are suspended from the ceiling to provide adequate light for the room. The classroom, as with the rest of the building, features an oversized oak door with intricate oak trim around the door, windows, closets, and whiteboards.

Whiteboards and bulletin boards cover the south and west walls of the classroom, while windows are on the east wall, and closet and storage areas are on the north end of the room. The plaster walls are painted the color of cream, while the ceiling is covered with white acoustical tiles. The original hardwood floor adds to the character of the 76-year-old classroom, with expected squeaks and creaks as the inhabitants move about the room.

Anna arranges her classroom with student desks in rows facing the northern end of the room. Five rows of desks span the room, with the middle row standing alone while

the outer two rows on each side are paired together. Behind the students is the entrance to the classroom as well as Anna's desk and a row of four multimedia Windows computer stations. At the front of the room is an overhead projector and screen, while a whiteboard spans the wall on the students' left and also houses maps appropriate for the curriculum covered in this grade level. The walls above the whiteboards and the bulletin boards are used to display curriculum-oriented posters, e.g. number lines, six-trait writing guidelines, problem solving strategies, and a vocabulary "word wall." The arrangement of furniture and students within the classroom remained constant throughout the research project. Anna's 23 fourth grade students (nine to ten years old) consisted of 11 males and 12 females; 18 students were of Caucasian descent, while three were African American, one was Hispanic, and one was multi-racial according to school enrollment records.

Seven short-term, drop-in observations were conducted during the research project, typically 15 to 20 minutes in length. Three extended observations were also employed as a part of the research, but were scheduled at Anna's convenience and lasted 45 to 60 minutes each. Observations were primarily conducted during the morning hours and most were during language arts related lessons, as this offered a large block of instructional time uninterrupted by special classes; the scheduled observations were also impacted by Anna working in a half-time position, sharing instructional duties of the classroom with her "job share" partner. Science and social studies lessons were observed as well.

Anna, a Caucasian female with twenty years of teaching experience, has been at the school for seven years following the previous thirteen in a diocesan Catholic school in the same city. She began her career later than many teachers, completing her bachelor's



degree in elementary education in her mid-thirties following several years of working in retail sales while raising young children. Although Anna has taken some graduate level coursework over the years, she has not pursued a graduate degree because “I didn’t feel it would help me that much.”

In order to better understand the classroom dynamics being observed, Anna’s teaching philosophy and beliefs that supported her pedagogical choices in the classroom were explored during the personal interview. She was quick to respond to this line of inquiry, stating that her goal in teaching was to help her students “become successful and productive and...able to function without the aid or assistance from the government.” Further prompting led Anna to expand her thoughts to include that this particular philosophy or desire did not fully develop until she began teaching in the public schools, where she encountered many children from impoverished homes. While her original desire to “help children” in her role as educator had not changed, her philosophy had altered over the years to include the concept that as educators “we give our students freedom – freedom from poverty, freedom from a lot of things.”

Observations began approximately one month into the school year to allow regular classroom routines and relationships to develop prior to the research beginning. In a format which soon appeared to be fairly routine, students had their books and materials on their desks while Anna worked from the front of the room, often utilizing the overhead projector to assist students in understanding concepts, demonstrating expected outcomes, and providing visual feedback on assignments the students were working through. The mode of instruction most typically observed in the classroom was one that Anna described as “direct instruction.”

The pedagogical choices made in supporting this teaching style were further defined by Anna during the personal interview, where she explained that she preferred “a quiet classroom, where the teacher gives instruction, gives the lesson, and then the students are able to practice a little of it while the teacher monitors.” She expressed concern that if students are “kind of doing their own learning, I’m not sure whether any of them are,” and that they don’t “really stay on task unless there is somebody guiding them or watching them.” Students commented during the focus group interview about Anna’s preferred mode of teaching, noting that “she’ll go up on the overhead and show us what we’re supposed to do and then give us a worksheet to do on it as homework,” and “she’s strict and she makes you pay attention and learn, and she’s really good at it, too.”

#### *Teacher Comfort with Educational Technology*

Whereas this project was fundamentally focused on how technology impacts learner interactions in the classroom environment, teachers were purposefully selected who were perceived to have different attitudes, perceptions, and skill sets in the use of educational technology in their classrooms. Anna, a veteran teacher, had been observed to use technology in her classroom at a minimal level, although she appeared open to learning how to use new tools in her teaching. In seeking to better understand Anna’s technology comfort level, permission was received to review a technology profile (<http://profilerpro.com/>) completed at the beginning of the school year for the school’s professional development program. The assessment provided a series of statements about the participant’s knowledge in the areas of operating systems, troubleshooting and maintenance, tool applications, internet and telecommunications, and multimedia

functions, with each item being rated as unable, adequate, familiar, or fluent. Anna consistently rated herself at the unable or adequate levels in all five areas. Permission was also obtained to review Anna's electronic professional development portfolio (the district contracts to utilize mylearningplan.com) which found only three events related to technology use or integration over the course of five years.

During the personal interview, Anna was asked to place herself on the *Levels of Adoption* continuum developed through the Apple Classrooms of Tomorrow research, which included the levels of Entry, Adoption, Adaptation, Appropriation, and Invention. Anna placed herself between the Adoption (using technology to support traditional instruction), and Adaptation (integrating technology into traditional practice) levels, stating "I'm using the computer basically as a word processor or as a typewriter to do the writing process," while "I'm starting to bring the computer in to do some extra research...I am trying to do a little more of the research and go a little bit beyond just the lesson."

Anna had continued to push herself professionally in learning how to utilize educational technology effectively, while admitting being frustrated at times due to the time spent troubleshooting technology problems, student errors in finding websites, etc., and feeling like "there's a lot of time wasted." She stated that she was "trying to use the computers more...to think of different ways to use them," and was currently working on the areas of word processing and research. An interesting caveat to Anna's discussion of the use of technology was the impact she has observed in her own planning:

I really think that there has been better planning for the lessons. I think before you would look at standards and say, OK, does this material cover the standards, and

if it covered the standards that is what I'd teach. But with using the computers you have to go a little bit further in your planning, and I think you think a little bit more about what you are doing and how you're going to do it because it's a management deal.

Anna's students also reported noticing her attempts to incorporate technology into her classroom, as Grace noted that they were beginning to use the computers more because Anna "wanted to learn more about technology...she's letting us do think.com [a secure, student-generated global online community] a lot because she wants to know how we use it, and lets us type stories." Tina noted that Anna "is really off and on with the technology thing...I think she is getting more into it because we are typing stories on the laptops," and Letitia added "when we work on technology she is real happy, and is like, ok, let's go...she likes the computer and the laptop and she says she wants to know how to go to sites and things like that."

Anna's comfort with and confidence in the use of educational technology were often confirmed in the pedagogical choices observed in her classroom throughout the research process. The majority of classroom visits did not involve any educational technology at all, which provided significant opportunities to view interactions in a relatively pure form and not influenced by technological devices.

#### *Interactions in the Absence of Educational Technology*

Although primarily teacher-directed on most occasions, students regularly interacted with Anna during the lessons. They would often raise their hands as she asked questions about the textbook, subject, or workbook they were studying, responding as Anna called on them individually. The classroom was normally tightly structured in

terms of how students behaved and responded to the teacher, but the tone of the classroom was generally positive as students and teacher interacted during the learning process, often with the teacher interjecting lighthearted comments and teasing with the students. At times students were noted to work independently at their desks with a textbook or worksheet, followed by a period of Anna questioning students about the content they were covering, e.g. “who is the main character?” or “what do you think they are going to do?” A number of observations found the students grouped in diads and triads as they alternated reading out of a selected text, again followed by a line of questioning from the teacher and an assignment for students to complete independently or at times in pairs or small groups. Anna described this technique as “we’ll do a reading together...then they each will work independently and then get with a partner and share their answers. If one of them has a different answer they have to go back to the book and prove...one of them has to prove which one’s correct.” Students echoed the finding by explaining that Anna often lets them “be with a group so you can figure it out together and know how to do it better,” and “we’ll get together with somebody and check our answers.”

During the process of observing the classroom over a period of time, it was found that observing personal interactions was difficult to separate from interactions with the content involved in the lessons. Interactions between learners were most often focused around content as the learners in the room responded to one another and the material they were covering. Anna stated that when instruction is primarily teacher-directed, “there is a lot of discussion going on, and if they don’t know the definition of a word they are real good about asking what that word means...students are not afraid to answer any

questions or ask any questions.” Students also noted that if they don’t understand a word or concept, they are able go up to the teacher for clarification, or at times can even “clap” (during choral reading) to signal that they need assistance. Julie claimed that “if we are having a problem with something we can go up to her and she will explain it...she’ll really help us with it.” Times did occur when interaction with others was minimal, e.g. when students were performing an independent task such as reading or completing a written assignment, although students were observed to ask questions of one another on occasion even while engaged in independent work.

One major exception to the direct instruction modality of the described non-technology lessons occurred during a science lesson that involved a number of “hands on” items, a group work product, and a significant change from the typical level of interaction and activity in the room. Anna had been presenting students with information about the process of classification, beginning the lesson with information, discussion, and questioning of students about their understanding of the content and process of scientific classification. Following the presentation, the students moved into groups of two to three to work collaboratively on an activity that entailed taking a random selection of buttons and classifying them by some distinguishing characteristic. Once the task was completed, groups worked together and attempted to discover how their peers had completed the task and what identifying characteristics had been used to classify the buttons.

Observational fieldnotes indicated that the noise level rose markedly in the room during this particular lesson as students interacted with one another to complete the task and to convince their peers of their reasoning and classification skills. Students were observed to excitedly collaborate on the task as they solved the problem at hand and

questioned one another in a manner that evoked higher levels of analysis than usually observed. Letitia described this learning experience during the focus group interview as she stated, “we learn best when we learn something and then we kind of act it out so that we’ll really get to know it,” while Thomas added, “if you do something that’s fun you remember it more than if you just read it out of a book.” This particular observation also led to a cathartic moment for the researcher as his general assumptions about the impact of technology on interactions in the learning environment were challenged by the fundamental lack of technology in this lesson, accompanied by particularly high levels of student engagement and interaction:

As I am sitting here and watching all of this, I am thinking that maybe the impact on interactions by technology is not as strong as I thought. Perhaps the impact of “teaching style” has more to do with it, and the utilization of technology fits better into some teaching styles than others. Anna is typically pretty structured and traditional, and I see a lot of knowledge and comprehension level questioning going on. Today as the kids are working on this science activity in groups with a task to complete, I am seeing higher levels of thinking...definitely application level if not even a bit higher! (O.C. 10/12/2005)

The vast majority of lessons observed in this classroom did not utilize any technology to speak of, and primarily relied upon an overhead projector and screen at the front of the room for display of teacher or student work. Two other lessons, however, incorporated the school’s wireless laptop computers, serving to provide a significant contrast to the non-technology lessons.

### *Interactions in the Presence of Educational Technology*

All of the shorter, drop-in observations as well as one of the extended observations were devoid of any educational technology. The remaining extended observations, however, incorporated the school's wireless laptop cart and provided a Macintosh iBook for each student. In both of these lessons, students remained at their desk and worked at their own desks on a specified task. The first was a social studies assignment requiring students to do independent research on Argentina, a country the class was studying for a special presentation. After receiving directions from the teacher on what website to go to, students began working to find facts about the country as they filled out a KWL graphic organizer (what I Know, what I Want to know, what I Learned). As the students began working, Anna proceeded to play a music CD featuring instrumental selections from the region.

Although students were completing an independent task, they visited openly during the activity, and observation notes included a description of "a buzz of noise in the room" as compared to other lessons. Three students (members of the school's technology team) were observed to immediately begin circulating around the room as the activity began, and assisting students who were having technical difficulties. After helping several students with similar issues, Grace loudly announced to the class, "When you go to [countryreports.org](http://countryreports.org), if it says it can't find the server you have to put in [www](http://www)."

Throughout the lesson, students would raise their hand if they were having problems and technology team members would leave their desks to assist their peers. Students often compared notes with one another and comments were shared at times to no one in particular, e.g. "Ooo, here's their flag" and "I can pronounce most of it" (in



reference to the Argentinean national anthem). Other students were observed to help one another during the task, most often in sharing information they had garnered during their research. Elizabeth in particular became a point of interest during the observation, as she often had behavior difficulties in and out of the classroom, displayed a significant deficit of social skills in working with her peers on a regular basis, and required a good deal of personal attention by her teacher. During this lesson, however, she participated at a level commensurate to her peers, and at one point went to another student's desk and "took over" her computer. Her classmate inquired, "What are you doing?" to which Elizabeth responded, "I am trying to show you something." Although her assistance was not entirely welcomed by her classmate, Elizabeth displayed a level of initiative and interest in this lesson not typically observed.

As the time for the lesson concluded, Anna then called attention back to her as students volunteered information to post on a group KWL chart. After a few minutes Anna transitioned into the school-wide reading block, but students retained their laptops on their desks. They were instructed to go to a new website hosted by the publisher of the school's reading adoption, and were guided to a pair of stories that they would read prior to completing a "compare and contrast" activity. After giving further instructions, students began to take turns reading aloud from the computer stories with Anna interjecting questions with class discussion following each paragraph. Observational fieldnotes referenced this variation to an often-utilized teaching strategy, as the computer text had replaced the regular basal reader:

It is interesting that we have gone from a research and discovery tool to an e-book being read aloud just as if they had their reading textbook in front of them. I am

wondering if the students are more engaged with the reading since it is on the computer than if they were reading out of the book. (O.C. 11/3/2006)

Students were asked about this observation and how they perceived the difference in pedagogical tools during the focus group interview. Thomas was quick to respond, “it’s more fun because you scroll down instead of turn the page...it’s more fun if you’re doing something different,” while Letitia described, “it’s hands on...more fun when you do something differently.” Stephen added that the reading task on the computers was “more interesting because you have better graphics...it will pop out better and be more interesting on computers.”

Of particular interest was the unusual role taken by students during the technology lessons. In non-technology lessons, students predominantly stayed at their desks, participated in the lesson as directed by the teacher, and responded to the teacher by raising their hand and waiting to be called upon. During the technology lessons, however, students regularly interacted with one another while working, and students with particularly good technology skills were called upon by their peers for assistance and freely moved about the room to assist where needed.

Anna referenced this phenomenon during the personal interview, in that students “learn to respect one another on a different level,” and that students “see that they [technology team members] are gifted, more or less, in the area of technology...I think they have a better respect for them.” She added, “They are really, really willing to help. They want to help the other students. And I just think it’s nice that the other students...they’ll let those kids help them, they’ll take direction.”

Students noted the difference as well, stating “if you sit by a tech team member they will really help you if you don’t know how to do something.” They also referenced that when they use technology in their classroom, the technology team “kind of takes over” in terms of leading the activity. Thomas described what happened to the teaching role during these lessons in student terms:

Instead of being the person that’s kind of ruling the classroom and telling everybody what to do, she [the teacher] kind of gets kicked off, and more people come up there that know what you’re doing. But she’s normally there for a little bit to tell you what you need to do, and then she kind of gets kicked off and then other people come up, and tell you where to go and what to do.

The second lesson that employed the wireless laptops was focused on a short writing project. Anna began by asking Tina how to log on to the school server, although not entirely sure that it was necessary for the lesson. While the technology team members began to circulate about the room assisting students with the log-on process, Anna explained to the researcher that she was just going to have them print off the documents at the end of the lesson and turn them in. The researcher demonstrated how students could log on to the server to save their work, as well as how individual student folders could be set up for the classroom. After one or two examples, Anna then proceeded to set up the remainder of the student folders on the server.

Students worked independently for the bulk of the hour-long observation, with technology team members called on occasionally for assistance. Students were also observed helping their neighbors from time to time with formatting and saving their documents. While originally intending to take a passive role in the extended observation,

the researcher was drawn into a more active role as a school “technology expert.” At times sharing a teachable moment with the technology team members in order for them to help their peers, the researcher also circulated to assist students with a variety of technical issues or helped the entire class with a problem they were all experiencing. An interesting phenomena occurred, although not fully realized until the researcher retreated to the back of the room to observe the last few minutes of the lesson: “As I ‘took over’ helping students troubleshoot, the tech kids went back to their seats and worked on their own projects and didn’t get up to help their neighbors anymore...I think I just took away their job!” (O.C. 12/14/2006).

Anna discussed the students’ teaching role after having an opportunity to review the draft report. She noted that, since a few students had taken the lead in helping with technology applications, choosing to use PowerPoint for special projects, etc., that additional students were “stepping up.” Anna added this perception as well:

I don’t think the kids would have been quite as anxious to do a PowerPoint if I hadn’t learned a little bit myself through this whole process; I think they probably would have been a little bit apprehensive. They know now that I’m ok with it so they’re ok with it; if they make a mistake...it’s ok.

#### *Learner Perceptions of Educational Technology’s Impact on Learning*

During the two lessons involving technology, higher levels of interest in lesson content and student engagement were consistently observed, in addition to students taking on a teaching role on a number of occasions. These perceptions led to further investigation through the personal and focus group interviews into how the classroom occupants perceived technology’s impact or potential impact on learning.

Anna noted that although she was not completely comfortable with the use of technology in her classroom, she saw a need to incorporate more technology into her teaching. She stated that it should be used “to supplement what the teacher does, and enhance some areas...some students are very good students and they like the enrichment from it.” She also proposed that academically challenged students could learn from technology as well, particularly in the area of writing, and that her goal was to expand her use of technology through research projects in science, health, and social studies. A concern noted earlier surfaced again as she said, “I just don’t want them to use their time goofing around on games or doing something that I can’t watch what they’re doing or they’re not on task.”

Acknowledging that technology can be of interest and a motivation to students, Anna described herself as “striving to bring computers into the classroom more.” The student engagement factor emerged as she reflected on the lesson involving the writing assignment: “When they were typing the other day you could have heard a pin drop. I think it was the second time we had had the computers...they were all just working away.” In describing her need to incorporate more technology, she proposed that technology’s impact on the outcomes of teaching and learning would not be significant to her, but it “would be significant to the kids.” She summarized her perception of this line of questioning by stating:

Students today are so smart about computers. Teachers are going to have to get on the same level – or at least try to get with students – or the students are going to think they’ve got a bunch of old fogies teaching...I don’t think they’re going to enjoy a classroom where there are no computers ever.

As the research inquired as to how technology impacted Anna's teaching, students also discussed how the use of technology impacted their learning. A common response to these questions was a simple "It's more fun," which required further probing to elicit a deeper level of response. A difference noted by Letitia was a more thorough level of understanding of content that inspired further discussion outside the classroom:

We learn more after we use the laptops because...we'll keep reminding them about it [the lesson material]. We talk to our friends more. Not while we're doing it, but we'll go to the library and stuff and we'll talk about the activities that we had [with the technology] and what it was about.

Julie also noted a deeper level of understanding in that "when we use technology we get to go a level up and learn more," while Grace echoed that when using the laptops the students have more fun, "but we're still learning at the same time. I think that my learning has changed a lot because sometimes when you use the textbooks you don't learn as much...when you use technology you learn a lot more." A number of students also mentioned that using the internet and e-mail applications were enjoyable, and Tina noted that technology is also serving to "bring people together" in terms of on-line activities and communication technologies. In answer to a follow-up question as to whether the class needed to use technology more in their classroom, the entire group replied with an emphatic "Yes!"

During an additional interview conducted with Anna after she had read the draft copy of the case study, she added a reflection in connection to the use of technology in her classroom. She stated, "I thought it was kind of interesting to hear the kids tell about me and how they thought I taught...that made me feel good...at the same time I don't

think that I'm hitting their interests all the time, because they do like the technology," and then added "I need to bring more technology in to keep their interest."

Anna indicated during this subsequent discussion that there was one particular thought brought out through the case study that made a big impact on her personally:

They want more technology, more interaction, and I really think they would prefer to manage more of their own learning, which is the one thing that scared me because I'm scared to death they are going to miss something along the way. But at the same time they may pick up something else that I hadn't expected for them to pick up, so it could be good if they start monitoring their own learning.

The previous sections have described findings related to learner interactions in Anna's classroom both in the presence and absence of technology as well as how learners perceived technology's current and potential impact of technology on learning. Finally, a discussion will be presented to consider the impact of the researcher's dual role on the research project.

#### *Exploring the Researcher-Supervisor Role Conflict*

The researcher, when proposing this research, knowingly undertook the project in a school in which he served as principal. The potential conflict between the researcher's dual roles was seriously considered and monitored throughout the project. Efforts were made to identify the researcher as such during the data gathering process – a large nametag worn on a lanyard identified the researcher as a university doctoral student and researcher. Still, it would not be surprising if the research subjects considered the researcher in his primary role of supervisor during the classroom observations, as he was in and out of classrooms on a regular basis prior to the research commencing. While the

researcher was unaware of any differences in the classroom due to the observer effect, the potential of such an effect was explored during the interview process with teacher and students alike.

A significant finding from Anna's perspective was an unexpected motivation to incorporate technology into her teaching. The invitation to participate in the study caused her to reflect on her teaching practice and a desire to expand her use of technology: "That's one of the reasons that I said I'd do it...because I felt like if I was being forced to do it – not that you were forcing me – but that if I was forcing myself I would do it. Otherwise I'm sure that I would not have used the computers." In response to the pursuit of further information about the impact of the research project on her teaching, Anna continued:

It's not because you're my principal and I was afraid to say no. I wanted to do it for me. I wanted to force myself to do it, but I knew it probably wouldn't be done if someone didn't nudge me a little bit and get me started.

Anna also expressed a level of trust with the researcher being in her classroom and acting in the participant observer role:

I respect you as a principal. There have been principals that I have not respected, and I feel like you've come into the room and you've helped. You've been an aide not only to the students but also to me...and you've taught me.

She continued her explanation of how the research had impacted her performance and instructional choices by stating:

I don't see you as a supervisor or as a principal...I see you as a person wanting to help make things better. And did it change anything that I did? No, not really...I



just never would have brought computers in and done research or any of the extras.

After a final inquiry of what role the supervisory function of the researcher played in her perception of the research process, Anna responded:

When you asked me to do it I thought I could say no and you weren't going to fire me or get rid of me, it was just a choice I had to make on my own. It was my choice; it was not your choice. It was something personally I wanted to do. I felt like if somebody is going to be watching me or working with me, then I know that I'm going to have to do it and it will force me to do it. It will put me on a timeframe or schedule...it's one of those things where I've wanted to do it, the opportunity came, and I just wanted to do it for me.

A similar line of questioning was pursued with students to gauge their reactions to the researcher/supervisor being in their classroom on a regular basis. While Letitia noted that she was "a little suspicious at first...but I got over it," Thomas observed that it "was kind of fun that you were in there," and Julie responded that she "felt comfortable because you would see what we were doing and maybe understand more what we do in our classroom."

While students confirmed a level of comfort with the researcher being in their classroom, they also indicated that the supervisory role did have an impact on some students. Julie offered that "some of the girls in our classroom like to talk and pass notes, but they don't pass notes anymore," and Thomas felt that "we were a bit quieter, because when you came in we either had the laptops or were doing something fun." Daniel, while at first stating that there was "no difference," later observed, "When you were in our

room she wasn't bad" in reference to a student who often had difficulties with behavior issues. Tina added to the conversation by reflecting that students were "better when you are in there because they thought you were writing things down about them." When asked whether they perceived these differences as due to the researcher doing research or to his role as principal, multiple students responded, "Because you're the principal."

Anna reflected on these comments after reading the draft case study and made this observation in regard to students perceiving their peers acting differently during the research: "I think if anything it would have been because they had to attend to a task – physically involved in doing something – they were actively engaged so they couldn't be fooling around." She added that, in regard to how students acted with the researcher present, "I didn't think the kids acted any differently."

The initial personal interview included exploration into what impact the researcher's presence had on her teaching, to which Anna confidently replied, "I continued doing what I was doing." A similar question was asked of students, who had a difficult time divorcing what Anna did in her teaching from how students acted in the classroom. Grace, however, seemed to have a better understanding of the question, and offered:

I don't think there is a difference [with the researcher present], because she doesn't try to act all good or like she's the best teacher and all. She just kind of goes with the flow and does what she's doing, and she keeps doing what she's doing and doesn't mind that you're in there. Well, she does mind, but not in a bad way...she doesn't try to act all good because she wants you to think she's the best teacher.

An additional observation regarding the impact of the researcher's dual role had nothing to do with how the teacher and students responded to the researcher's presence. Separating the roles was more difficult than imagined for the researcher himself. After years of observing classrooms from the role of instructional leader, the researcher would occasionally reflect on occurrences in the classroom that had little to do with the research context. One such entry in the observation log included the following excerpt:

I went into principal mode for a moment and had to forcibly return to observing interactions. I am so used to observing teachers and commenting on what *they* are doing that it is difficult to look just at the interactions occurring in the classroom. Hopefully this will get easier. (O.C. 9/26/2005)

The process of observing as researcher became easier as the task continued, but even two months later the "principal hat" would briefly surface once again during a lesson in which students were searching for information from a reading passage: "Should she have talked about the strategies at this point? Are there any questions that would be easily found? Which ones? Could they process the information as a group? Here go the principal questions again" (O.C. 11/28/2005). These events occurred less frequently as the study continued and the researcher gained experience in the participant observer role.

Finally, reflections during the months of data collection and analysis indicated that a pleasant and unexpected result came as the researcher and participants "have become closer having gone through the process," and another entry from the reflection log indicated that "I know without a doubt that there is a great deal of wonderful teaching going on in their classrooms, and now I have a much stronger appreciation for what it is they do every day." To gauge whether this observation had anything but personal merit, a

follow up question was asked after Anna had an opportunity to reflect on the draft case study:

I am a lot more honest and I am a lot more...anymore I feel like I can trust you and I can tell you about stuff, and you're going to be fair about it and give good direction. It doesn't bother me anymore to come and talk to you...so I think you being in the classroom more has helped our relationship in being more honest and open and trusting each other.

Anna further discussed her perception of the trust issue as she reflected on allowing her students to participate in the focus group interview process.

I've got to trust you that even if the kids came in and said [Anna] is an absolutely horrible teacher...we hate her guts...that you would tell me that and you would work with me to become a better teacher. For those kids, I had to trust you in order to talk to my kids about me, and if I didn't trust you I wouldn't want my kids talking to you. I think it opened up a lot of dialogue between you and I.

This discussion continued by extending how the lessons learned from the observations and relationships might hold valuable implications for practicing administrators, particularly in encouraging them to get into classrooms more often. Anna immediately added to this line of thought with "in a non-threatening way. They have to be in there not with their notepads taking notes and watching this, but working with the students, working with you on some things." Her final thought on the research process simply stated, "it's brought dialogue between you and I that we probably would have never had."

The case study discussed in the previous pages described salient findings from the research in Anna's classroom. A second case study is presented in the following section, standing separately from the previous discussion in analysis and presentation of findings.

### *Case Study #2 – Barbara's Classroom*

Barbara's classroom is found in the center of the second floor of the school, just across from the school's main staircase. The room is approximately 23 x 30 feet in dimension, and with a full wall of windows on the western exposure of the building it is not uncommon for the room to be a bit warm in the afternoon. Barbara's desk can be found in the southeast corner of the classroom surrounded by a desktop computer, portable bookshelves, and built-in cabinetry full of a variety of teaching materials and books; the work area is located to the far right side of the front of the classroom. The east wall is covered with a large expanse of slate chalkboard in addition to maps, television and VCR, and pull-down slide screen. A coat closet is located on the north end of the room while the southern wall features a series of bulletin boards covered with curriculum items, e.g. math "problem of the day," calendar activities, etc. As with the other classrooms in the building, an oversized oak door and detailed dark oak trim highlight the early 20<sup>th</sup> Century architecture of the school, including the original wooden floors in the classroom. The walls are made of plaster and painted off-white, and acoustical tiles cover the high ceiling.

Student desks are arranged in several small groups of four, with pairs of desks facing one another, and the arrangement remained largely unchanged throughout the research project. The number of students in this classroom was somewhat smaller than a typical year due to an additional classroom being added at the grade level. Nineteen

students made up this third grade class of eight and nine year olds, of which 11 were male and eight were female; 12 of the students were Caucasian, five were African American, and two were multi-racial according to school enrollment records.

Two rows of fluorescent lights span the length of the room, and student artwork is often displayed by hanging items with string from the lighting fixtures or craft wire strung across the room. On the south end of the classroom, aligned with Barbara's work area, are four Windows computer stations that face the south wall. The computers are spread out over several tables, making it possible for more than one student to be engaged at a terminal simultaneously. A video projector and laptop computer, in addition to an overhead projector, are located at the front of the room next to a portable podium.

Eight short-term, unscheduled observations were conducted during the research project and were typically between 15 and 20 minutes long. In addition, three extended observations were conducted and lasted between 45 and 60 minutes each; Barbara provided scheduled lessons of her choice for the extended observations. Observations were spread throughout the school day, with five short-term and one extended observations occurring in the morning while the remaining three short-term and two extended observations took place in the afternoon. Subject matter observed included reading, math, social studies, and science.

Barbara is a Caucasian female in her mid-forties, who began teaching immediately after graduating from a state university as a traditional "college to classroom" teacher. She served as a reading teacher for four years in a small rural community while pursuing her master's degree in reading, wherein she gained an additional endorsement as a reading specialist. Barbara moved to this urban school

district 19 years ago and has taught at two different elementary schools. Her last five years have been spent in her current assignment.

In order to better understand the context of the classroom and the underpinnings of Barbara's teaching, the interview began with an inquiry regarding her philosophy of teaching. Barbara struggled with this question initially, stating "I've always said the year that I come to school in the fall and don't fall in love is the year I need to find something else to do...I just love the kids and try to help them." After pausing for a moment, she continued:

It has to do with being a family in your classroom, helping kids, helping each other. I really feel in my heart that what I do is important. I think some people have jobs that aren't important, but I really feel in my heart that what I am doing can make a difference.

Later in the interview Barbara was speaking about her preferred mode of teaching, and after a potential connection between her statements and her teaching philosophy was pointed out, she agreed and summarized:

I truly believe in the science model where you give kids stuff and then they come up with their questions, and then that directs your instruction to a certain point. They still – with reading and math – they still have to learn certain things. If you can, give them the tools and let them see the direction that it goes and kind of go from there.

Barbara also referenced how her experience had impacted her philosophy and approach to teaching. After beginning her career in a small rural community with "families of friends" where "everybody knew everything," she moved to an urban district

and a school located in an impoverished neighborhood. She thus reported that this experience resulted in a significant impact on her beliefs:

Those kids were so needy. I was there 15 years, and some days I felt like they sucked the marrow out of my bones...they were so needy. I hope that I'm a better teacher. I think having my own children has changed my expectations and my philosophy on teaching...knowing what kids can do and kids have problems, and trying to help kids that have problems.

Observations in Barbara's classroom began approximately a month into the school year, which allowed for classroom norms and routines to be fairly established prior to the research commencing. A common element seen throughout the observations included a laptop computer and projector at the front of the classroom. In years past, Barbara utilized an overhead projector instead, but had been working on digitizing many of her materials and adding to her arsenal of visual teaching tools. She explained this instructional choice during the interview, stating, "I'm a visual learner, so I think at times I am more of a visual teacher. But I try to say I'm a visual learner but you might not be...this is how I might do this but not necessarily how you would do that." Barbara added that she also believes that "there's not just one thing that's going to get everybody. You kind of have to be multi-pronged...you have to kind of try to see where people are going and try to help them."

Students also noted a variety of instructional activities in the room, with Craig commenting that, "she tries to...help us learn by doing things that are fun and make it as painless as it can be." Others found that Barbara would often "give us the answers and give us the last few by ourselves" with Sally adding, "she'll come over and help us figure



out how to do it better” when students are struggling with concepts presented during whole group instruction.

### *Teacher Comfort with Educational Technology*

In seeking to understand how learner interactions were impacted by technology use in elementary classrooms, teachers were purposefully selected for the research project who were perceived to have different attitudes, perceptions, and skills sets in regard to educational technology. Barbara, a veteran teacher, had been observed over the course of the previous year to embrace a belief that technology had a place in her classroom, and often sought assistance from her colleagues to more thoroughly integrate technology into her teaching.

All staff members at the school completed a technology basic skills assessment at the beginning of the school year to assist in directing the school’s professional development program (<http://profilerpro.com>), and permission was received to review Barbara’s technology profile in order to better understand her comfort with educational technology. The self-assessment provided a series of statements about the participant’s knowledge in the areas of operating systems, troubleshooting and maintenance, tool applications, internet and telecommunications, and multimedia functions, with each item being rated as unable, adequate, familiar, or fluent. Barbara predominantly rated herself at the adequate and familiar levels in all five areas of the assessment. In reviewing her [mylearningplan.com](http://mylearningplan.com) professional development portfolio, eight instances of technology-related events were found over the past two years, several of which were in reference to the writing of a technology grant.

At one point in the interview, Barbara was also asked to place herself on the *Levels of Adoption* continuum developed through the Apple Classrooms of Tomorrow research, which included the levels of Entry, Adoption, Adaptation, Appropriation, and Invention. Barbara first placed herself between the Adoption (using technology to support traditional instruction) and Adaptation (integrating technology into traditional practice) categories, but then reflected that she was “more at the Adaptation stage...I think I’m still learning. We use it every day and I’m trying to get it into the kids’ heads that it can help them and what they need to be able to do.” While pursuing this questioning further, Barbara explained, “I’m on a learning curve...there’s a lot I need to learn yet, but I’m trying. I kind of put myself out there...learning with the kids, I think. We’re both learning together on some things...I’d say I’m a beginner.”

Barbara’s efforts to incorporate technology into her classroom while learning along with her students were often visible during the classroom observations, while a number of observations were absent any technology at all. An exploration into learner interactions in the classroom environment, both with and without technology, was necessary to further understand the research context.

#### *Interactions in the Absence of Educational Technology*

Early attempts to categorize interactions as involved with content, technology, or people proved difficult at best, as interactions between the occupants of the classroom were most often related to the content they were covering. In order to better understand the interactions in the classroom, it became necessary to look at interactions in general, yet separated by when technology was present and when it was not.

When the classroom was engaged in whole group instruction in the absence of technology, Barbara would often cradle a textbook or other materials in her arm while she maneuvered around the classroom, and at other times would station herself at the overhead projector or laptop/projector system while she presented content to the class. One such occasion found Barbara and her students with their reading basal, working on whether items read were fact or opinion. She was leading the class to orally recite some hints that they had apparently discussed previously, e.g. statements that begin with “I think” or “I believe” are opinion. She then presented additional statements as the class responded chorally with “fact” or “opinion,” and she would reinforce their response with statements such as “that’s a fact.”

Following the review Barbara began to read aloud a story about sharks. Periodically she would stop, asking the students whether the previous reading was fact or opinion, to which the students would chorally respond. After the class responded as a whole, Barbara would specifically ask individual students to explain their reasoning, assisting them as needed or asking another student to help their peer with the answer.

Other observations would find students with a small whiteboard, dry erase marker, and “sock eraser” at their desks while Barbara led them through a number of instructional exercises. These occasions were often rapid fire in terms of the speed of the lesson, with students listening, quickly writing answers on their whiteboards, and holding them up for a moment for Barbara to check. She would typically move throughout the room during these lessons, occasionally engaging personally with a student as she acknowledged a correct answer with “I think it is, too!” or “We’re good!” Other times found her assisting an individual student for a moment to explain a concept or what was

missing in their answer. Barbara's explanation of her concept of her students as a family was also observed in her interactions with her students, often laughing with them, calling them "Babe," and teasing them when their efforts needed further attention, e.g. "Show me your work, Matthew...gonna get beaten with a wet noodle if you don't!" Following periods of whole group presentation and practice were typically moments of independent work where students were observed to work quietly, often referenced in research fieldnotes as "Students continue to work at their desks on their own throughout the period" (O.C. 10/6/2005), and "All were working independently as the teacher walked around the room" (O.C. 11/30/2005).

An additional strategy observed on a number of occasions was the use of instructional centers. Students would work either independently at their desks or at computer stations, while a small group worked with Barbara. The rotations were observed across subject matter, and often included what Tommy referred to as "fun but educational games" during the independent portions of the center activities. Barbara's instructional focus during these periods was found in the back corner of the room, which featured an area rug, a small whiteboard on an easel, and a rocking chair. Barbara would typically be seated in the rocking chair during this small group activity with the students gathered on the floor at her feet.

During these small group lessons, Barbara would utilize the whiteboard along with a variety of student materials, e.g. worksheets or "read along" books. In one such lesson Barbara listed a number of consonant blends on the whiteboard, and as she sat down in her chair she asked the students "What are we looking for?" Students proceeded to work in pairs as they read through the reading selection and used a highlighter to mark

the blends found in the passage. Two students who struggled with the lesson were directed to “come sit by me,” and Barbara assisted them with their task as they worked through the lesson as a group. On this particular occasion, the researcher joined the group on the rug in order to better hear and observe what was transpiring, and two students responded by sitting on either side of the researcher and engaging him in the activity with questions such as “will you help us?” and “what other blends do you see?”

Another small group lesson was focused on a vocabulary activity while the teacher asked students about words related to the previous whole class reading lesson. Interactions during these activities were observed to be primarily teacher initiated as she asked questions, prompted, and waited for student responses. Students appeared to be very comfortable in the centers activities as well as in helping their classmates during instruction. Lisa, for example, stated “if someone is right next to me and they ask me what we’re doing right now, I can finish hearing the directions and then I can tell them,” and Matthew reported “people really help each other when they’re having a hard time.” Jeremy also contributed “when some kids don’t know a word, they might ask you and you can tell them what the word is.”

Most students appeared to engage in the small group lessons very intently, participating with the teacher and performing the tasks required. The climate was always positive and appeared to be one in which students were comfortable with asking questions when they needed assistance or didn’t understand a concept. Lisa, for example, noted “if you need help with something you can ask her, if you don’t know a word and the people beside you aren’t there you can ask her,” while Danita added “I think she’s friendly.”

Attention was drawn to David on one particular occasion – a student who had been observed to often struggle with the grade level academic content being presented in the class or in the small group. Reflections from the fieldnotes included the following:

I noticed one student, David, off to one side of the group, and he appeared to be struggling with the lesson, at times waiting for other students to respond to prompts and then parroting their response. A similar technique was being utilized for writing the required answers...he would wait for another to respond and then try to write down the word. (O.C. 10/19/2005)

This observation was discussed with the teacher following the lesson, as David's well-disguised discomfort with content had apparently resulted in his developing a number of coping skills that masked his actual ability and achievement. Barbara acknowledged this perception and noted that David was a concern and one who often received additional attention and instruction.

While a number of lessons were devoid of educational technology as pictured above, others were observed to utilize a significant amount of technology and focused integration of technology tools. The contrast between these two lesson formats provided additional information to consider during the search for meaning in this observational research.

#### *Interactions in the Presence of Educational Technology*

In approximately two-thirds of the observations conducted in this classroom, some form of educational technology was utilized. Within those technology lessons, two basic applications were found. The first was predominantly seen on those occurrences where instructional centers were employed. While Barbara worked with a small group on

particular skills at the rug, the remainder of the class engaged in other assigned activities. One group was typically assigned to the desktop computers while the rest would work at their desks on an independent activity with a handheld computer. The use of the handhelds usually included students working on a math flash card application or a game called “Blocks.” Barbara indicated during the interview that “we use the Palms all the time,” while Sarah later explained during the focus group interview that “we use the Palms everyday...it’s a privilege for when you get done.” Once at the desktop computers, students were allowed to self-select from a number of activities supporting the current subject content, e.g. math activities during the math block. Observational fieldnotes reflected, “At times the students worked in pairs on the sites, collaborating...other students worked alone, and I observed some students jumping from one site to the next during their rotation” (O.C. 10/14/2005).

Activities observed during the rotation activities with the handheld and desktop computers were typically very quiet with little interaction between learners, save an occasional quiet conversation with a neighbor. A general perception arising from this scenario was that students were expected to engage in fairly quiet activities while the teacher was working with a small group on academic content – a perception confirmed by Barbara in a subsequent conversation. Students were also at times noted to be less engaged with the handhelds and desktops as they worked alone; Barbara considered this during an additional interview following her reading of the draft report. “That could be...I think that’s accurate. I had never thought about that...when we use the laptops we have a particular task” as opposed to the self-selected activities on the handheld and desktop computers.

In approximately one-third of the observations, the class was working with the school's Macintosh iBook wireless laptop cart, allowing for all students in the class to have their own wireless computer and internet resources. It was during these lessons that the researcher was occasionally pulled into the classroom activity by students as they worked on a variety of activities. The first such occasion, early in the school year, came during a drop-in observation. Students were observed to have their laptops at their desks while Barbara was working with an individual student, and as the researcher entered the classroom several hands shot in the air and one student silently mouthed, "Help us!" As the school's building-wide wireless network was not yet installed, connectivity involved making sure the laptop cart was plugged into the wired network before the laptops were turned on. After observing a look of frustration on Barbara's face, the researcher diagnosed the problem and instructed students to restart their computers and the problem was solved. Barbara reported following the lesson that she had "just told them all to get quiet and that they would work out the problems they were having connecting to the network."

Students proceeded to work on a variety of activities, including a science-oriented web quest and their think.com (a secure, student-generated on-line community) web pages, an observation that was made on a number of occasions. While students worked independently on their laptops, there was more activity and conversation in the classroom than during the non-technology observations. At times this was due to students visiting with one another informally as they worked, and other times due to more active questioning of the adults and other students in the classroom as troubleshooting or content issues arose. David, for instance, asked for help as he was trying to type in a web



address for an internet site and was having problems, stating “I’m not very good at typing.” Another student, Jeremy, also grabbed the researcher’s attention to tell him to “go to my website and look at my pictures.” The classroom appeared very informal during these lessons, and Barbara would walk around working with students individually, laughing occasionally, and responding to students as they raised their hands; at other times students also seemed comfortable just asking for assistance or conversing with the teacher, particularly if she was within close vicinity.

Students, in addition to asking adults in the room for assistance, were regularly observed helping one another during the laptop experiences. They would freely move about the room while they were working, observing what their peers were doing or asking for help. David and Joseph, for example, gathered around Jeremy while he was inserting some clipart into a project he was working on for a Kazakhstan report, and David stated, “Show me how to get that to that art stuff.” At another time, Ross was having problems with a PowerPoint assignment, and his neighbor assisted him in formatting his title. Another student, Sarah, often would come to the researcher for assistance when he was present, which Barbara noted “doesn’t happen when you’re not here,” and was likely due to a “fatherly” connection that had been developed with the student previously while her father was out of the country for a significant time due to military duty. The example of this students as teachers finding was perhaps most well illustrated during one lesson when a student got Tommy’s attention and stated, “Dude, I need you,” at which time Tommy went to his peer’s desk to assist him with his technology question. Barbara had previously “crowned Tommy the think.com king,” and he was regularly observed serving as a resource for his peers.

Two additional occurrences were noted that seemed of interest. David, previously referred to as a student who struggles academically and asks for assistance from adults and students on a regular basis, was observed on one occasion moving to Michael and then to Chloe, helping them find some desired information on the internet. Another occasion involved Jenny, a special education student who was often out of the classroom as she received intensive academic support due to her disability. She was present, however, for a number of activities each day, and methodically followed along when the classroom worked on the laptops. Her seatmate, Jeremy, was periodically observed to move to Jenny's desk to assist her with the task at hand, and would help her if she got behind the rest of the class.

In exploring the students as teachers concept during the interview, Barbara reflected:

I think one of the most interesting things is that the kids can learn from each other, and they realize that there are some things that I'm not good at. And its good for me to step back and say I'm not sure how to do that, but so and so does...go ask them.

When students were asked who their "go to" people were in their classroom in regards to technology, they immediately identified Tommy and Sarah. Upon further inquiry into how these students acted differently than others, the immediate response from students included "they're really careful with it...they don't like, mess around with the laptops like a lot of the kids do," and "they don't stand up and jump around with the laptops." After further prompting as to how these students contribute to the classroom,

Craig responded, “they help people on the laptops more often than other people do,” and Jeremy added that they “helped people get pictures into their PowerPoint.”

After observing technology being utilized during a number of observations, an inquiry was made as to how Barbara viewed the role of technology in her classroom.

Barbara reported:

We use the Palms all the time; we’re using the computers all the time. They’re doing research...we’re studying about Kazakhstan. Well, who knows anything about Kazakhstan? No one...so we’re able to access that information. We’re actually able to talk to Michael [her nephew serving in the Peace Corps] in Kazakhstan...that’s just amazing, it really is! The communication piece is just pretty interesting.

Students concurred during the focus group, adding that they “use the computers for research,” “doing projects,” or working on “blocks, rocks, or flash cards, or a puzzle, or a math quiz.” They were also repeatedly concerned about how the technology tools should be treated in their room, as Lisa noted they should “treat the laptops like they are yours” and Tommy pointed out that the laptops are to be “used at your desk” while Sally stated “almost all of us want to make sure the computers don’t get broken, or the laptops, or the Palms don’t break.”

#### *Learner Perceptions of Educational Technology’s Impact on Learning*

While fieldnotes indicated that students were involved and typically engaged in the non-technology lessons, a higher level of engagement was repeatedly observed during the lessons involving technology hardware and applications. When asking Barbara to reflect on how her teaching varied with the use and integration of educational technology,

she replied, “Hopefully its more interesting. Sometimes you can take some of those concepts that we do have to teach and make them more attractive to the kids.” Students spoke about this finding in terms of their excitement toward technology use in their learning, with Jeremy commenting, “When we can play on the Palms when we’re finished with our paper, a lot of people just slop through the paper and don’t even read the questions” in order to get to the technology faster. Craig also observed that, “Sometimes certain people run up the stairs to get on the computers or get the Palms, and I think if we didn’t have them the people won’t be running up the stairs because they won’t be that excited.” To further explore this topic, a line of inquiry was followed in the personal and focus group interviews to gauge how the learners in this classroom viewed technology currently impacting their learning and what potential impact they believed lay in the future as technology integration continues to develop.

Barbara had been repeatedly observed to be at the forefront of efforts to upgrade and expand the school’s technology resources over the past two years. In reflecting on the role technology should play in elementary classrooms, she stated:

I think it should make my job easier. I think it should make the world...the children should have the world at their fingertips, which they basically do. If it can take some of the drudgery out of my job, the office part of stuff that you have to do, and focus more on learning. I think its neat when the kids can do projects that can take some of the standards and things and incorporate them into them coming up with something.

Having been in the teaching field a number of years and a part of the technological evolution that has occurred also caused Barbara to reflect on the past as she considered future ramifications:

When we first started using technology you went to the lab, you sat down – it was drill and kill – and in third grade we did keyboarding. How stupid is that? That’s not computer skills, that’s not...and I’m not saying typing is not important, it is... but I hope they can use technology as a tool to do whatever job they need to do.

Barbara was also asked if she felt that she needed to incorporate additional technology integration in her teaching, to which she emphatically replied, “Oh yeah, I think I’m just at the beginning stages.” Further exploration into what she envisioned yielded the following comment:

I just think there’s so much out there available, so many things you can do. If we had a set of clickers [a computer-driven application that allows students to answer multiple choice items with an infrared handheld device] and they are doing something, they can give me their answer immediately and I can know immediately who got it right, who got it wrong, and I can pull the kids that didn’t get it right and do a re-teach right there immediately...right away. To me that would make a lot more sense than by the time the kids do something on paper, by the time I grade it and get back to them and pull that group back or whatever or see what they’re doing...to me that would be more timely to help the kids with their learning.

Additionally, Barbara desired to have more technology available, including having half of her class working on computers at a given time, a SMART Board and

Airliner (interactive white board tools that are computer driven and tied to a video projection system), and additional hardware and software applications as well as further professional development to support her teaching, as she concluded, “I’ve got a long way to go.”

When originally proposing the study, concern was expressed that this particular class could potentially be challenging to interview due to the students being eight or nine years old. The challenge was truly realized during the focus group as students struggled to think beyond their current experience, preferring instead to focus on concrete concepts having to do with student behavior and how they should treat the technology. Questions were often pressed, reformed, and rephrased – explaining without leading to specific answers – but the jump to the abstract often proved difficult for most who were a part of the focus group.

Sally, for instance, felt that more technology in the class would not be a particularly good idea, as “if they behave badly the whole class doesn’t get the computers,” and “if someone is doing the wrong thing and we don’t have computers so often, then they would be like oh, I’m causing us not to get the computers because I’m being bad...so they would stop maybe.” Craig, however, felt that “we probably should use more technology in our classroom...if we did it more often then they would get used to the rules and maybe stop doing that and be doing what they’re supposed to.”

Students did feel that technology was making a difference in their learning even though they had difficulty envisioning the future. Jeremy, for instance, noted that “I think we should use technology more because it helps us learn about different stuff...it helps us learn geography and do research.” Lisa offered that technology “helps you learn how to

cooperate and get research stuff,” and Tommy added, “with technology it’s a little easier to learn, so she doesn’t have to explain all of these things and we’re doing it. If someone has a question it makes it a little easier because she’s showing us how to do it.”

In terms of the future impact of technology in her classroom, Barbara proposed that there would be a difference in her classroom over the next few years:

Hopefully I’m doing more technology, hopefully I will have some of those things that I would like to have, and would hope that maybe the kids are more project-based – where these are your parameters, see what you can come up with. Just give them some guidelines and hopefully more of that project-based kind of stuff that integrates everything – math, reading, writing – all inclusive.

Findings have been described in the previous pages related to learner interactions in Barbara’s classroom, both in the presence and absence of technology as well as how learners perceived technology’s current and potential impact of technology on learning. The final section of this case study will explore what impact the dual role of the researcher played in the research project.

#### *Exploring the Researcher-Supervisor Role Conflict*

As was the case in the first case study, the researcher similarly addressed the potential researcher-supervisor role conflict from the onset of the research through the methods previously described. Recognizing the potential of the observer effect to impact the research subjects and the data collection process, the subject of a role conflict was pursued during the interview process with both students and teacher.

In seeking to understand the impact of the observer on her classroom, Barbara was asked to describe how she felt about her supervisor conducting this research, to which she responded:

I was glad you were in my room, because I like for you to know what's going on...and to me if it had been someone else that I didn't know or the kids didn't know or were comfortable with, to me they would have put on airs or done something different. But since I think we all were so comfortable...everybody was relaxed and doing what they would have been pretty much whether you'd been there or not, hopefully myself included. I think it was fine because everybody was comfortable, very comfortable with the whole thing.

Students also referred to their comfort with the researcher during the focus group interview. Craig began the conversation by stating that he “felt nice because its like you keep coming in like you like coming in here. It seems like we are doing a good job in what we're doing...it makes me feel like I'm doing a good job,” while Tommy stated that he “felt good...I know that I have a computer expert in there that I can ask a question.” Lisa then added, “I feel privileged that I can have someone that is really good with computers come in and help us.”

During the conversation with Barbara, she was asked to describe how the dual role of researcher and supervisor had impacted her teaching and day-to-day decisions in planning for her lessons, to which she immediately responded:

It didn't. Is that a good thing or a bad thing? Maybe because of my age and doing this so long...the one thing that you've made me feel very comfortable about is if



I can't figure something out I can ask and you will come and help. And to me that's what you need, and you need it when you are having the problem.

In terms of whether the researcher's presence affected her mode of delivering instruction, Barbara indicated that what was observed was the "same as always...didn't change it. This is who I am, this is what I am, that's it. I'm not normally a 'dog and pony show' kind of person." Students agreed that Barbara's teaching was no different when the researcher was present, as Lisa summarized that his being in the classroom "didn't really change the way she taught."

As students and teacher reported no change in regard to Barbara's teaching during the research activities, an inquiry was made as to whether there was any observable impact on how students interacted with their teacher and each other. Barbara responded to this question with "I didn't notice any difference. I really didn't. Sarah wants to hang on you, but other than that...they love you!" While usually attempting to enter classrooms as inconspicuously as possible during the research, personal connections that had been made with a number of students caused a bit of disruption on some occasions, although often limited to the beginning of the observation. Students reported this effect as well, with Sally noting that sometimes students "shout 'Mr. Miller!' when you're there instead of raising their hands," while also asserting that they don't ever do that with their teacher. Students also typically reported that they usually stayed in their seats during instruction, with Denita stating "because they need help they choose to get out of their seat" to engage the researcher.

Although Barbara noted no appreciable difference in the students other than the personal connections that occurred, Lisa found that at times Barbara would "get

frustrated about people yelling for Mr. Miller, but she thinks its ok.” Lisa also reported one additional impact she observed with certain students, which was confirmed by the rest of the group:

Some people in our class play games when they’re not supposed to when you’re not in the classroom, they’ll be playing on think.com or whatever. When you’re there they’re acting all different...they act like they have it under control and they’re doing what they are supposed to be doing.

Barbara reflected on this student perception after reading the draft report of the case study. She noted that students were likely referring to one particular student, as “sometimes we have trouble getting him on me...sometimes I get focused on what’s going on over here and not so much on what’s going on over there.”

An additional observation in terms of the potential role conflict came from the reflections of the researcher himself, as the separation of researcher and supervisor roles proved more difficult than originally expected. The “principal hat” had been worn for over fifteen years, and the habit of looking at teaching and learning through the researcher lens was a new experience. Two such occurrences were found in the data collected fairly early in the research. One occasion questioned the instructional validity of a student task: “What function does the blocks game play? Students were engaged with the Palms but I was not sure what purpose there was to the game” (O.C. 10/4/2005). The second data point was found in the observation log two weeks later, and considered the management task of the teacher in using instructional centers in her classroom. The reflection noted, “How does the teacher monitor what she is doing to insure productivity? Is this an administrative or researcher question?” (O.C. 10/14/2005).

Such events occurred in all classrooms involved in the research as the researcher became accustomed to this new role. The process of observing from a researcher standpoint became easier as the study continued, and such events occurred less frequently as noted in the fieldnotes and reflection log.

The researcher also noted a perception that he had become personally closer to the research participants over the course of the study, and now had a much deeper understanding of their teaching, their students, and their commitment to the task of teaching. In pursuing whether Barbara had seen any difference in the principal/teacher relationship resulting from the research, she stated:

I think I feel closer. I feel – you’re not a threatening person at all – but I just feel like its more collaborative, maybe...if anything, maybe more collaborative, and [the research] made me feel more comfortable that you know what I do every day. Even though I think administrators kind of know what goes on in classrooms, I think when they come in more often they get a bigger picture.

The case study discussed in the previous pages described salient findings from the research in Barbara’s classroom. A final case study will be presented in the following section, and stands separately from the previous discussion in its analysis and presentation of findings.

### *Case Study #3 – Christie’s Classroom*

The third and final case study was conducted in Christie’s classroom, also located on the second floor of the school. The classroom is located on the north end of the structure, in a part of the building that is not original but an early addition and similar in appearance to the rest of the school. With dimensions measuring approximately 25 x 36

feet, the room is one of the largest classrooms in the school, with large expanses of windows on the entire eastern exposure and about a fourth of the north wall as well, reaching from approximately four feet off the floor nearly to the top of the 14-foot ceiling. Two rows of fluorescent lights, suspended approximately six feet from the ceiling on metal rods, provide ample artificial light for the room. While similar in appearance to other classrooms in the school with its off-white plaster walls, detailed oak trim and oversized oak door, the classroom has a dark, often discolored, green tile floor.

Christie's work area is located in the southeast corner of the classroom, with her chair sitting between a single pedestal desk often covered with teaching materials and a computer workstation table that houses her desktop computer and printer. The furniture arrangement allows Christie to swivel between her two work areas while remaining open to the rest of the classroom. Across from her computer station is another table, butted directly up to it, that contains another Windows computer and a flatbed scanner, both of which are in a common work area for students and adults. The remainder of the south wall is covered with a black slate chalkboard lined with butcher paper and utilized to display student-generated work.

The west wall of the classroom is also covered by a slate chalkboard, behind which is the classroom coat closet. Above the chalkboard is a map rail with grade level maps appropriate to the grade level curriculum in addition to a pull-down slide screen. The north wall is covered by a large expanse of bulletin board that serves as the classroom "word wall," and additional curriculum posters are seen on the walls above the chalkboards and bulletin boards. While student desks fill the bulk of the main space of the classroom, two additional areas are set apart from the rest. In the northeast corner, a

small area rug and pillows surrounded by several bookshelves and a variety of reading materials make up a small reading and lounge area. A separate space in the northwest corner finds a solitary table with one chair on each side set in front of the word wall. The space was found throughout the research to be designated the conferencing table, where Christie and individual students would meet to discuss progress on a variety of products.

Student desks in the classroom are arranged in pods of desks containing six or seven individual desks, typically two rows of three facing one another with an additional desk facing the others at the end of the pod. The desks are generally arranged to have visual access to the west wall of the room, where Christie has a small table with a laptop computer and projector set up for projection on the screen. The general arrangement of student desks varied somewhat during the observation period, as Christie regrouped students on a monthly basis and moved desks as needed to accommodate new seating assignments. Christie's 27 fifth grade students (ages 10 and 11) consisted of 15 males and 14 females, of which 21 were Caucasian, two were African American, one was American Indian, and three were multi-racial according to student enrollment records.

A total of 12 observations were conducted in Christie's classroom, eight of which were short-term and unscheduled, lasting approximately 15 to 20 minutes each. Christie also scheduled three extended observations with her choice of time and subject, each lasting between 45 and 60 minutes. With only one exception, the observations were conducted during the morning hours. Several issues impacted the research occurring throughout the day, including a late lunch period for the classroom, which caused the morning session to be nearly an hour longer than the afternoon session; the researcher was also often engaged in his supervisory role following the lunch period. Christie

specifically asked not to be observed during the afternoon math period, as she had just begun teaching math again after several years of teaming with another teacher and being primarily responsible for the language arts area. This request was honored since she was not comfortable with data being collected during that time frame. Finally, the last period of the day in this classroom was used for a self-selected reading period, which after one observation was determined to provide little to observe.

Christie is a Caucasian female in her mid-thirties who has been teaching for five years, the last three at the research site. After beginning her college coursework at a private, faith-based university following high school, she delayed completing her degree after two years to begin raising a family. She returned to the university at the age of 29 to finish her degree and begin her teaching career. While currently not holding an advanced degree, she is contemplating beginning a masters degree program in the near future.

In an attempt to better understand the context of the classroom and the previously conducted observations, the personal interview began by inquiring about Christie's philosophy of teaching. Without hesitation she stated:

I believe that I'm here to be a guide on the side. You hear that – sage on the stage, guide on the side – and I want to be able to fulfill my responsibilities of covering the standards and making sure the kids know content, but I also want them to grow as people and I want to give the opportunity to be able to do that within the classroom. I think that is as much my responsibility as it is to cover content...I want them to have a good, positive experience and come out knowing more than they did.

Although relatively new to the teaching career, Christie indicated that her philosophy has changed somewhat in the past two years. “I think I’ve become more understanding toward students who don’t always learn a certain way or don’t always act a certain way or aren’t the ‘cookie cutter’ student.” She went on to reflect that she feels that she has “a knack for helping those kids or at least attempting to, because I think that everybody deserves to have a good experience at least one year of their school career...I don’t think I felt that in the beginning.” In terms of how that discovery has impacted her teaching practice, Christie added:

All kids aren’t “cookie cutter” mold – they’re different – and they’re going to have different learning styles, but they’re also going to be just different, and I think you have to approach them differently. And I think if one thing doesn’t work you need to do something else, and if that doesn’t work you need to do something else, and I don’t think I really thought about that until last year. It really changed me...in a good way.

Research observations commenced approximately one month into the school year, allowing time for classroom rules, procedures, and relationships to be established. A significant number of visits found students engaged in a variety of activities as a group, at times a major project and at other times a paired or group discussion of the content being presented. Christie explained her pedagogical choices during the personal interview:

I’m very much project-based. I like to present a project, make sure it covers standards, tell the kids why we’re doing it, tell them what the outcome ought to be, and then I like to break it down. Then I like to not be up on the stage with the kids, so I’m lecturing the kids and they’re listening to me. I like to help them to

complete assignments and complete projects so that they have a product that they are proud of in the end...I'm not always able to do project-based things, some things don't lend themselves to that and that's OK, but that is my preferred method.

Christie continued with describing how she attempts to reach students with different learning styles and abilities by noting "I feel they learn best by doing. I do try to keep in mind my kinesthetic learners, my auditory learners, my visual learners...I'm a visual learner myself." She sees that using a computer and video projector at the front of the room this year has proven an asset as "we do a lot of things with technology and I thought I needed to have that there for the kids...I feel like they learn best by me modeling what we're going to do and then them doing it."

During the student focus group interview, students noted the presence of Christie's preferred pedagogical devices. Jessica stated that "she does visual learning and it helps me a lot because then I can see what I need to do," while Andy added that her preferred method of teaching is "by showing you." Nathan expanded the visual perspective by tying in the value students place on the technological aspect of Christie's teaching. "I think we learn the best when we see it on the projector because everybody wants to look at it – because it's cool and we want to know what's going on."

#### *Teacher Comfort with Educational Technology*

In an effort to understand how learners interact in the elementary classroom setting coupled with the impact educational technology may have on those interactions, teachers were purposefully selected who had demonstrated varying levels of technology expertise and integration in their classrooms over the course of the previous year. Christie



had been observed to be at the forefront of using technological resources in her classroom, often serving as a resource to her colleagues as the school's site technology specialist. She added on a pre-interview questionnaire that her goal in her classroom is to "integrate technology into everyday classroom experiences...I want technology to be like a pencil and paper are to my students."

The school's teaching staff had all completed an online technology basic skills assessment at the beginning of the school year (<http://profilerpro.com>) as a part of the process for planning professional development activities, and permission was received to review the results of Christie's self-assessment. Included in this tool are a series of statements for rating individual knowledge in the areas of operating systems, troubleshooting and maintenance, tool applications, internet and telecommunications, and multimedia functions, with each item being rated as unable, adequate, familiar, or fluent. Christie predominantly rated herself at the fluent level in all five areas of the assessment. A review was also conducted of Christie's [mylearningplan.com](http://mylearningplan.com) professional development portfolio, which discovered 20 technology training events attended over a period of three years and many related to her role of site technology specialist.

In exploring this topic further, Christie was also asked to place herself on the *Levels of Adoption* continuum developed through the Apple Classrooms of Tomorrow research, which included the levels of Entry, Adoption, Adaptation, Appropriation, and Invention. Christie responded with wanting to place herself between Appropriation (incorporating the technology as needed and as one of many tools) and Invention (discovering new uses for technology tools), stating that had there been a choice between the two "that would be me!" Reflecting further, she noted:

When I look at appropriation, I see project-based, interdisciplinary – that’s me...incorporating technology as needed – that’s me. I want to have a whole learning environment that is online, that is on the computer, that is able to be accessed by all of the kids. I want to have forms online that they do – that is what I want but I’m just not quite there yet.

Christie’s passion for integrating technology into her classroom was observed on a number of occasions, while other observations found no technology being utilized at all. The study was designed to discover what, if any, differences occurred in learner interactions when technology was present, so the dichotomy of use provided appropriate data to consider in interpreting this research.

#### *Interactions in the Absence of Educational Technology*

While initially setting out to categorize interactions by whether they were with people, technology, or content, this soon proved difficult as the bulk of interactions within the classroom centered upon the content and subject matter being presented. Therefore, it was concluded that interactions within the classroom would be more generally described within the context of when technology was absent followed by additional descriptions of interactions when technology was a factor.

During approximately one third of the observed lessons, there was no technology being used in the classroom. These lessons primarily consisted of Christie leading a discussion or presenting information to the class, with students working individually or in groups. On several occasions the researcher observed Christie sitting on a stool at the front of the room as she talked to the class, often engaging in lighthearted banter with her students. One such lesson included students working individually on a vocabulary

worksheet that had boxes to be filled in with vowels or consonants, and Christie would give hints as to what the words were. Students would attempt to guess the word from the progressive hints and be the first one to get to the right answer, holding up their hand, wiggling at times, and even bouncing in their seat as they desired to be called on. Christie would announce either “Correct!” or “No!” as students answered, and students with correct answers to this “working with words” activity would excitedly go to a treat jar to retrieve a reward. Although this lesson was largely teacher directed and interactions primarily teacher to student, fieldnotes indicated that students “appeared engaged in the activity and were filling in the appropriate words as they worked through the worksheet” (O.C. 9/26/2005).

Two non-technology lessons were observed to exhibit what the fieldnotes referred to as “high levels of engagement.” In the first, students were found to be working in several groups spread around the room with most groups gathered around a cluster of desks. Each group exhibited high levels of involvement and engagement as they worked on several different assignments related to a program about Vietnam they would later present to the entire school. Fieldnotes provided further description about the activities found within the groups:

One group was talking about how to plan a skit that would present the statistics.

One was working on building a time machine that they could tie into the presentation, and also was working to divide the research needing done between the members of the group. Another was planning a TV show that would cover part of the material, which would be videotaped in order for one student to be a

part of the presentation who was going to be out of town for a cancer checkup.  
(O.C. 10/13/2005)

Throughout this lesson Christie was observed to move around the room from group to group and ask questions about what they were doing, at times prompting students to elicit further thoughts or information to provide clarity to their project.

Another occasion found Christie located at the front of the class leading a lesson on text structure – an activity initially described as an independent teacher directed activity. Students had a laminated “text structure work mat” on their desks and a selection of text passages, and Christie would instruct students to read the passage and individually determine what text structure type would be the best choice, e.g. descriptive, cause and effect, compare and contrast. After a few moments however, Christie instructed the groups of students to work together collaboratively to arrive at a group answer, at which point groups would be asked to share their answer with the rest of the class. If unclear, she prompted for further information with statements such as “why do you think that is compare and contrast?” or “tell me more.” On one particular passage, Christie asked students to place their “finger on the organizer you think fits this story.” After quickly surveying the room she noted, “I only see two people who are correct,” followed by an explanation that “this is a tricky one” and the class then working together to fill out a graphic organizer appropriate for the passage.

Group activities much like those described above were observed on a number of occasions during data collection, often enough that fieldnotes reflected “group work is often a norm” (O.C. 11/30/2005). Students also described other activities during the focus group interview that were not observed during the research. Ashley noted that Christie at

times lets students “teach the class certain things...if someone else knew something better than the rest of the class, she would let them teach a little bit about it and how they found an easy way to do it.” Katelynn described a previous lesson where separate groups collaboratively researched and contributed to a project on the branches of government. After researching their topic, the groups developed a poster and “wrote little sketches on the poster...then everyone would come back in the classroom and we’d put them on the board and everybody in the group would have a certain part they would read from the poster.”

While a few lessons were observed that didn’t involve any educational technology at all, the majority of lessons seen in Christie’s classroom would be technology intense. Significant examples of learner interactions in the presence of technology were found to provide a contrast to the interactions described above.

#### *Interactions in the Presence of Educational Technology*

The majority of observations in Christie’s classroom found at least some level of technology being utilized, from a minimum of the teacher’s computer being projected on a screen to each and every student having a laptop computer on their desk. Interactions in the presence of educational technology will be explored in the following paragraphs.

In one such lesson, the observation began toward the end of the math block. A final activity of the lesson included the students working on a math facts application on the classroom set of handheld computers. Fieldnotes indicated that, while students were not interacting at all with one another, they all “appeared to be engaged with what they were doing.” Following the conclusion of the lesson, and in what was found to be a typical daily activity, the students pulled out their academic planners while Christie

stationed herself at her laptop at the front of the room. The class reviewed what they had done during the day, telling Christie what to write on the projected document.

Following the completion of their planner activity and homework reminders, they proceeded to copy down the information into their individual planners. The projector and laptop at the front of the room was utilized a great deal in the classroom, even in the absence of other technologies. Christie indicated that she had found this tool very helpful for visual learners, as “they learn best when I break things down and I make sure they know step by step what we’re going to do,” also noting that, “I can’t believe I didn’t use this last year!”

Laptop computers were found to be an integral part of a number of the observed lessons. Interactions between learners varied with the activity prescribed by the teacher, and two examples are provided to demonstrate the differences observed in learner interactions.

The first lesson found the teacher sitting at the conferencing table, where she would call students one at a time to come discuss their progress on a current writing project. While this activity was occurring, most of the remaining students sat quietly at their desks with one of the school’s Macintosh iBook wireless laptops on their desks; one student was working with a handheld computer and wireless keyboard, while another had an encyclopedia on his desk. Most students had completed a paper story web prior to this lesson, and were proceeding to complete internet research on various topics found within their individual graphic organizers. Notes taken during this observation reflected “very little interaction was observed other than an occasional comment to me about what they were working on” (O.C. 11/28/2005).

Christie talked about the variety of expectations for her students during the personal interview, and particularly referenced the above lesson:

I think they do know that my expectation is when we are doing whole group, and when I am up and I am on the stage that they need to be quiet, that they need to be listening – actively listening – and participating, especially if there’s a discussion. I think they know, too, when its time to do Writer’s Workshop...that it’s time for conferencing.

Jessica noted these differences as well when she stated, “sometimes she lets us talk, but most of the time we’re quiet and listening to her.”

On another occasion all students were again found to be working with a wireless laptop. A previously observed lesson was related to this particular observation, and at that time they were planning for a PowerPoint slideshow they would compose as an “alphabet retelling” of a self-selected novel they had read. Prior to this lesson students had handwritten how they would compose their retelling on paper templates, which included a series of statements utilizing all 26 letters of the alphabet to begin their sentences while keeping the retelling in chronological order.

The observation was conducted as the students were beginning to move their paper template to electronic form, and students were visiting with one another as they worked. As the researcher walked around the room observing the lesson, students were observed to be working independently, and Ethan asked the researcher for assistance in importing a graphic for one of his slides. As Christie maneuvered around the classroom helping students as needed, it was noted that Ethan had moved to another student’s desk and was assisting him with importing a graphic into his presentation. The phenomenon of

inserting clipart began to spread around the room, and the researcher was soon pulled into the lesson as students came for additional help with the process. After showing Carrie how to complete the task, she was soon after at Kim's desk helping her with the same process. Carrie called from across the room and asked, "Do you click yes?" Following the affirmation of her demonstration she continued to assist Kim and others around her.

The students as teachers phenomenon continued as Ethan assisted additional students and was asked by Christie to help Andy, to which he replied "in a minute" since he was helping another student at the time. Allen volunteered that "I can" and went to the student in need, helping with the skill that Ethan had shared with him just a few minutes earlier. Even with the students helping one another throughout the lesson, fieldnotes indicated that it was "very quiet in the room today...students are spread around the room, some at desks, some at tables, some going to hallway to work on a digital video for their website portfolio" (O.C. 10/25/2005).

Christie indicated an awareness of students' comfort in helping their peers as they utilized educational technology in her room, stating during the personal interview:

You find a lot more collaboration when we're doing a web quest or when we're doing any kind of online searches or when they're doing research...I think they're more apt to help a kid who is trying to Google search something than one who is trying to find something in an encyclopedia. I just think it lends itself to a more collaborative environment.

Students also noted how they were able to work with their peers when they had a level of expertise to share, as Dan found "if someone is having a problem on the computer, like connecting to the server or something, they can call you over and you can



help them with that,” with Samantha adding “sometimes she’ll show us how to do things and then we can show other students in our class and stuff like that.”

The observations made of students at times taking a teaching role during lessons involving technology were explored during a follow-up interview with Christie, to which she added, “It gives them a feeling of self-worth, to be able to teach somebody else how to do something.” She also professed a belief that those feelings of self-worth, coupled with success in being able to teach a peer, translated into increased connections with teachers and a desire to perform at a higher level in other curriculum areas.

The role of technology in this classroom was also discussed with Christie during the initial personal interview, where she saw very little difference from where she currently is and where she wants to go with the use of technology tools:

I think it should be – we talk about “just in time” with technology – I want technology to be as common as a pencil and paper in my classroom. It’s not going to be yet, because it’s still new...or relatively new. But I’m seeing that it’s not as new as it was last year, as new as it was the year before. I don’t want them to be so enamored of the technology that they’re not learning...I want it to be a tool. I strive to do that every day. I don’t know if I succeed, but I try.

Students added to the conversation about technology’s role in their classroom during the focus group, with Ashley noting that “I think she likes teaching better with the technology because more kids like it,” and Jessica adding “I think she really likes technology a lot because she enjoys using it.” Nathan summarized with “we use it a lot...that’s basically all we use for assignments and stuff.”

Technology appeared to play a significant role in this classroom as demonstrated in the lessons described above. Further information about how the classroom's occupants perceived any impact educational technology is having on their learning would serve to strengthen the understanding of the observed interactions.

*Learner Perceptions of Educational Technology's Impact on Learning*

Lessons that involved some form of educational technology often appeared to have higher levels of student engagement and interest than lessons without technology. Christie reflected about this perception with her own learning over the past few years, noting that she began teaching with no technology and then was provided a classroom set of six handheld computers for a special project. Even with such a limited amount of technology to work with, she found:

It just opened up a whole new world to me. I saw my kids engaged and learning and doing, and I was just amazed and I really had to stop and I thought to myself, ok, this is what I want to do, this is how I want to do it, this is the way I want to go, and I made a decision right then that I wanted to try to integrate technology as much as I could into my classroom.

Christie also referred to a conversation with a peer consultant teacher from outside her school, who told her "this is you, this is your gift, you need to do this, you're very good with this...this is really your strength," and the experience "really changed how I was doing some things to make sure I was using technology."

Students in Christie's classroom also reported on their learning being impacted by her integration of technology into their lessons. Ashley simply stated at the beginning of the discussion:

I think the technology helps kids want to learn more about what we're doing and she'll let us do it on the Palm or something. Or when we're typing something – more kids want to do it because they get to work with the technology, which is fun...I think they like to learn better when they're working with the technology.

Susan continued the conversation with “I think technology is more fun for the kids to learn, and it's more attractive,” and Andy echoed “They like to use the technology to learn.”

Unlike the other two case studies, learners reported that they used technology “a lot,” “all the time,” and “almost every day...actually we do use it every day.” Christie reflected that:

I feel like as far as handhelds, the laptops, internet connectivity – I think we're where we want to be. I'm pleased with that. I think I could do different things, but I don't know that I could do a lot more right now...I feel like I'm where I need to be with technology.

Students affirmed Christie's intense use of technology by reflecting that they couldn't or shouldn't use technology more than the current level, with Ashley finding “we use technology a lot, and I think we use it enough,” while Samantha added “I think we probably do it as much as we should.”

Another finding that surfaced during the focus group interview with students was that technology was allowing students to interact more with their peers. Dan, for instance, stated that “if you really didn't know them that well you can get to know them maybe a tad bit better” while helping other students with technology problems, e.g. connecting with the server, and others confirmed that helping one another often led to interactions

with students with whom they typically would not interact socially. Additional discussion centered on the use of think.com, a secure student-generated global online community. Katelynn stated, “On think.com you can leave stickies and interact more, and also their pages might tell about them,” and Susan offered that “you can go to think.com to their sites, and find out what they like, and you can see what they like.”

Nathan also noted that using the handheld computers in the classroom sometimes led to similar interactions with students outside an immediate circle of friends:

If we don't have a game, we go to other people and see if they have the game, and if they have the game we either try to see if we can use their Palm and play on it...or they can beam us a game. And then we start talking because they beamed you that game and you want to be nice to them and thank them.

This example triggered another thought from Jessica a few minutes later in terms of working with one another on the technology team:

I went to install a computer with another student that I don't necessarily talk to because I think she's kind of weird, and so we could talk about technology while we were installing this computer, like what cord went into which little slot...it was really interesting.

Findings related to learner interactions in Christie's classroom have been described in the previous sections, including learner interactions in the absence and in the presence of technology, as well as how learners have perceived the impact technology is having on their learning environment. A final section of the case study will investigate the impact of the researcher's dual role as researcher and supervisor on the participants and the research project.

### *Exploring the Researcher-Supervisor Role Conflict*

As a result of this study being conducted in a setting where the researcher simultaneously served as principal and supervisor of staff and students, additional attention was given to the potential role conflict that might exist as the researcher was in and out of classrooms multiple times each day. As in the previous case studies, a large nametag identifying the researcher as such was worn during data collection activities, and students were made aware of the project prior to it commencing. The researcher continued to be aware that the research participants were likely to consider him in his predominant role of principal as he was in and out of their classroom. Thus an exploration into this potential observer effect was explored with participants during the interview sessions.

When asked how she felt about the researcher conducting the research in her classroom, Christie responded quickly, “It didn’t bother me at all.” She continued by explaining that, as a technology savvy teacher, she had been the subject of many observations and visitors over the years, which “really conditioned me.” Christie went on to explain:

I’m not nervous about that just because I feel like for the most part I’m doing what I should be doing when I should be doing it. My philosophy has always been that I should teach like there was a parent sitting in my room, so I do. It hasn’t really bothered me that you’ve been in there. I also feel like you’re probably in my room more than you are in other rooms just because of the technology aspect...I feel like we interact more than you do with some teachers, so I wasn’t bothered by it.

Likewise, in response to how the dual role had impacted her day-to-day decisions in her classroom, she stated, “I don’t think it did...is that bad?” while adding that the presence of the researcher did not impact her instructional delivery “at all.” Students offered similar information, with Susan noting that “she sees you – she’s used to it – she’s comfortable around you because she doesn’t act like she’s scared,” and Ashley offering, “I couldn’t really tell if she was trying to teach any better or anything.”

While looking at the impact of the research on the teacher, the interviews also inquired as to any possible impact on the student participants. Christie noted, “The students are also used to you being in the room. I feel like they were being pretty honest, pretty typical, they weren’t acting much different than they do normally.” Students reacted to the researcher’s presence in a positive manner, with Katelynn finding “I think that you’re helpful to us if we’re doing a project and [our teacher] can’t help us right now because she’s helping another person...you’re like an extra teacher and can come and help us.” Jessica added a comparison, with “Last year, you didn’t come in our classroom as much and we got really tense when you came in. This year when you came in it was just like...hey!” Another student contributed that students “got used to you being there,” while Andy added “you can barely tell you’re in there because you are so quiet...you just walk into the classroom and go to the back of the classroom...it’s like you’re not even there.”

Students indicated that a few students did appear to be impacted by the researcher’s presence to some extent, with Ashley observing “I think that some kids act like they know what they’re doing more when you’re in there...if they don’t know something they try to act like they do,” and Samantha adding “some people might behave

a little better.” In reflecting about these student comments after having an opportunity to read the draft case study, Christie believed that the comments were a result of students’ “preconceived notion of what goes on when you are in the room...I don’t really feel like the kids are ever like that in my classroom because you’re there so much.”

An unexpected impact came in terms of the initial difficulty of separating roles by the researcher himself. With many years of observing classrooms from an administrative point of view, looking at classrooms from an unbiased research standpoint was a new experience for the researcher and required a period of adjustment to the new role. One such reflection was found early in the data collection when the researcher noted, “I was looking at the appropriateness of the vocabulary in this lesson...need to focus on interactions!” (O.C. 9/26/2005). Another example came in reference to one student who often was a challenge for the teacher due to negative behavior, and was a periodic visitor to the school office for disciplinary action. The researcher commented on this student in the fieldnotes, e.g. “Phillip made numerous comments during the period, most about skateboarding, some sarcastic. Were these for my benefit? Did the teacher even hear him?” (O.C. 10/31/2006). Adjusting to the researcher role required a period of time and redirection of the researcher’s observation skills. As the study progressed, the occurrences of these events became less frequent, and the researcher became increasingly aware of when the supervisor role was slipping into the observation process and fieldnotes.

One additional reflection, following the data analysis and a period of processing the findings, was that the researcher felt more professionally engaged with the adult participants. An entry in the researcher’s journal indicated that the process of conducting

the research had demonstrated how “non-threatening observations in classrooms, when there is an element of trust, can assist in strengthening relationships in schools – while at the same time assuring those being observed that you value them as employees and friends.” In a follow up interview, Christie was asked how she perceived any differences in the researcher/researched relationship, to which she responded “I think you’ve been in my room a little more than last year...but I think I’ve always communicated what I’m doing and when I’m excited about something.” A moment later she added, “I feel like we worked pretty well together last year, too...I didn’t feel a big difference, I think we were already there.”

The findings of the three case studies, resulting from a period of data collection and analysis, have been presented in the previous pages as separate descriptive case studies. To conclude this report, a final chapter follows that presents a discussion of the findings from across the case studies in addition to a number of conclusions that were drawn from the research.



## CHAPTER 5

### Discussion and Conclusions

The findings from this research project were presented in the previous chapter in the form of individual descriptive case studies. As the report continues, a number of conclusions gleaned from the research findings will be presented in this final chapter. The chapter is organized in a similar manner as the case studies, and focuses upon exploring the conclusions derived from the data by emphasizing Teaching Philosophy and Pedagogy, Teacher Comfort with Educational Technology, Learner Interactions and Pedagogical Choices, Learner Interactions and Educational Technology, Learner Perceptions of Educational Technology's Impact on Learning, and finally, Observer Effect on the Research. Following the presentation of the conclusions, a discussion of the implications of this research is presented to conclude the chapter.

#### *Teaching Philosophy and Pedagogy*

Every teacher develops a personal philosophy of teaching that influences their daily planning, instructional delivery, and connections with their students – their own personal teaching style – that Heimlich and Norland (2002) defined as incorporating the “beliefs, values, attitudes, working philosophy, skills, and personality” of the teacher (p. 19). The manner in which teachers teach was also referenced by Stitt-Gohdes (2001) and Sandholtz et al. (1997), who posited that most teachers teach in the same manner that they learn. While personal teaching styles may be adjusted over time due to personal experiences and professional opportunities, the learner is most often left to adjusting their style of learning to the teaching style of the teacher (Brown, 2003).

The research project described in these pages found three teachers, selected purposefully for their distinct teaching styles and use of educational technology, who held markedly different philosophies and beliefs as well as varied pedagogical approaches to teaching. Anna, in the first case study, was inspired by a desire to help students become “successful and productive” citizens not dependent on government assistance. Her drive to reach this goal was accompanied by a preferred teaching style that included a “quiet classroom” where she is in control of the learning process in order to guide and watch what her students are doing. Anna has approached the integration of technology in her classroom cautiously, struggling with students being responsible for their own learning and concerned with “wasted time.”

The second case study found Barbara, whose philosophy was predominantly fueled by her personal belief that her classroom is like “a family” and where the primary focus is “helping the kids...helping each other.” Pedagogically, Barbara admitted being drawn to the “science model” that enables students to discover learning in their own manner, with her providing guidance and the tools students need to accomplish the desired outcome. Technology use and integration in her classroom fit within her philosophy of discovery as Barbara and her students learned together.

Christie, the teacher in the third case study, embraced a philosophy to be the “guide on the side,” where she helps students to “grow as people” while having a “good experience” in her classroom. She also expressed a desire to be aware of students’ differing styles of learning, with a preference for delivering “project-based” instruction that allows for student choices and differences in learning styles while completing projects that result in student products “that they are proud of in the end.” Integration of

technology in Christie's classroom appeared to be given extensive attention as she strived to have technology function as a tool and be "as common as paper and pencil."

A variety of guiding philosophies were found in these classrooms, accompanied by teaching styles and pedagogies that the participants believed to best serve the needs of their students. Evidence was consistently found throughout the research that indicated that the teachers selected particular modes of instruction that closely aligned with their personal philosophy and beliefs about the process of teaching. Based on the research in these three classrooms and the resultant findings, it was concluded that there is a definitive connection between each teacher's guiding philosophy and beliefs and the pedagogical tools they employ in the delivery of instruction to their students. Significant to this connection is that when a new tool or method of instruction, e.g. the integration of educational technology, is introduced and perceived as contrary to their guiding philosophy (as in the case of Anna), adoption of such an innovation is difficult to embrace.

Intertwined within these varied teaching styles also lay each individual teacher's preference for interactions within their classrooms. Anna's preference for control of the learning environment supported how students were arranged within her classroom and expected to engage in discussions at her direction and when called upon. The climate in Barbara's classroom was often loosely structured and students were observed consistently engaging their teacher and one another while participating in learning activities. Christie's classroom, fed by her desire for students to work with one another on project-based activities as she facilitated the process, often resulted in students regularly interacting with one another as they collaborated on assignments. The data from these

three classrooms thus led to the conclusion that the guiding philosophies and beliefs of teachers have a significant impact on how students interact with their teacher and one another during the learning process.

During the investigation of philosophical and pedagogical issues with students, they consistently indicated an understanding of how their teachers teach. Although not speaking as adults would in reference to this subject, their perceptions were aligned with what their teachers had reported. In Anna's class, for example, students described her teaching as showing "what we're supposed to do" and following with a worksheet to do "as homework," while also noting that "she makes you pay attention and learn." Barbara's students explained that she helps students learn "by doing things that are fun" and by helping students to "figure out how to do it better." Students in Christie's classroom also described their teacher's preferred pedagogical techniques as "she does visual learning" and that she teaches "by showing you."

In light of the data presented in the findings related to student perceptions of pedagogical issues, it was concluded that students are definitively cognizant of how their teachers present instructional material. Findings also indicated that elementary students willingly accept the pedagogical techniques utilized in their classrooms as normal in the context of their current classroom assignment, regardless of other teaching styles they have been exposed to or with little reference to how students perceive they learn best. It was thus concluded that elementary students readily accept their teachers as experts, and that their method of teaching is the "right way."

### *Teacher Comfort with Educational Technology*

Within the context of this research project, the frequency of use and integration of educational technology into instruction was widely varied as a result of the purposeful selection of teachers who were perceived to possess different teaching styles and skill sets in the use of these tools. Anna, who had experienced very little training in the use of technology and possessed a healthy skepticism of its place in her classroom, employed very little technology in her classroom. When attempting technology integration, she tied such usage to current instructional practice, e.g. reading from the computer instead of a book, or completing an individual assignment electronically. Anna's own assessment of her skills rated her as unable or unfamiliar with many of the functions of educational technology, basically using the computers as "a word processor or as a typewriter." She described herself as "between the Adoption and Adaptation" levels of technology adoption, and indicated that she was trying to learn more about using technology in her classroom and that such attempts have led to "better planning" of her lessons.

In the second case study, Barbara indicated that she had experienced a moderate level of training in the use of technology tools, and rated herself as adequate and familiar in most areas of a technology skills assessment, while stating that she was "on a learning curve" as she and her students were "learning together." Barbara, in reviewing the levels of adoption descriptions, suggested that she was currently integrating technology into traditional practice.

Christie, in the final case study, was found to have experienced significant training in the use of technology resources. She rated herself as fluent on all but one subset of a technology skills assessment, while incorporating technology into project-

based, interdisciplinary units and utilizing such devices as tools to support instruction and student learning – each of these components supporting her self-placement at the Appropriation level of technology adoption. Christie’s current use of technology varied from individual project-based assignments to technology-rich research projects and group collaboration as she sought to fulfill a vision of a fully integrated electronic classroom.

For two of the participating teachers, college coursework was completed over two decades ago when technological resources were in their infancy and teacher preparation in the use of technology, according to Anna and Barbara, was limited to introductory computer classes and audio-visual tools, e.g. using a filmstrip projector and properly threading a movie projector. Interestingly enough, Christie also indicated that she had experienced only one college class that focused on technology during her coursework as well, even with her teacher preparation coursework occurring within the last several years.

As additional technology has become available, teachers have often been left to their own devices to learn how to use these tools by experience or by seeking out additional professional development on their own. The purposeful use of such technologies has been tied to the individual teacher’s pedagogical beliefs and values (Cox et al., 2003), while successful implementation occurs as teachers reflectively tie these tools and applications to their own pedagogical beliefs (Zhao et al., 2002). In looking at these three classroom teachers and their placement on a continuum of technology use (Coughlin & Lemke, 1999; Dwyer et al., 1990a; Newhouse et al., 2002b), a living portrait is provided to demonstrate the wide variety of technology knowledge and skills found within a single school.

As individual teachers pursue further professional development, they must also see a benefit to incorporating new tools while adjusting their practice with new skill sets and resources (Pisapia et al., 2000), as they simultaneously recognize the importance of educational technology as a tool for learning (Heath et al., 2000). An example of this phenomenon was observed in the first case study, as Anna had experienced minimal professional development in the use of technology, was less than willing to change her instructional methods by giving over control of learning to students, and thus chose to continue practices that matched her philosophy and beliefs. The second case, while featuring a more experienced teacher than the first, found Barbara willing to pursue additional resources and training to expand her teaching arsenal coupled with a desire to incorporate new learning into her classroom, often learning along with and from her students. The third case study found a recent college graduate, Christie, with significant time and training in the use of technology, and like the first case study pursuing teaching practices that matched her philosophy and beliefs, even though the teaching behaviors of both teachers were substantially different.

Substantial efforts to provide classrooms with the best technological tools available were observed within this study, while little evidence was found to support more than an initial site-based effort to train teachers to use such tools and thoroughly integrate them into their teaching practice and philosophy. As such, teachers were often left to their own devices to incorporate these tools into their daily practice. In applying Piaget's theory of accommodation (Piaget, 1962) – the application of previous learning and understanding to new experiences – to an adult learning context, the findings of this study suggest that new learning can take place when teachers have an innate sense of

discovery and desire to expand their arsenal of teaching tools, as seen in the second case study. Such accommodation can happen when strong foundations to new learning are not significantly in the past and provide a springboard to new learning, as observed in the third case study. The accommodation of new skills can also happen, as observed in the first case study, when teachers are provided a motivation to learn new skills and subsequently observe positive student reaction to the use of new practice.

The minimal site-based training found at this school, in combination with the teachers' professional development experiences and stated comfort level with technology, led to the following conclusion: In order for teachers to make substantial and meaningful use of the technological tools at their disposal, while at the same time adjusting or changing their pedagogical approaches, opportunities to subsume new learning into previous knowledge must be consistently provided in a manner that differentiates instruction to meet the needs of individual teachers.

An additional caveat to the research process, and one deeply woven into the fabric of the emergent design of the research, was found in the impact the research had on teacher introspection and self-analysis. This was perhaps most evident as the three teacher participants had opportunities to discuss the research with one another and provide the researcher with their additional insights following a review of the preliminary findings as well as during ensuing discussions as the project neared its completion. Participation in this project in effect became a source of professional development for the teachers involved. As a result of observing these teachers learn about technology and about themselves by participating in the research process, it was concluded that teachers benefit significantly from involvement in activities that challenge them to look deeply at



their own practice and to be active learners as they dare to incorporate these new practices into their classrooms.

Evidence was repeatedly observed within these classrooms that as teachers grew more comfortable with the technological tools at their disposal and began to integrate the use of technology more deeply into their pedagogical practice, interactions between classroom occupants often increased and became more student-centered, and often resulted in the teachers relinquishing some level of control of the learning process to their students. Thus it was also concluded that increased interactions between students and teachers, particularly as teachers give away control to their students and learn along with them and from them, contribute to a more collaborative environment where all inhabitants of the classroom learn from each other.

#### *Learner Interactions and Pedagogical Choices*

Throughout the three case studies, interactions between the occupants of the classrooms were observed and findings related to when technology was absent and when it was present during the observations were presented. Increasingly throughout the study, it was noted that interactions within these two scenarios were often very similar, and as such this discussion now considers the impact teaching techniques, or pedagogical choices, have on how learners interact within the elementary classroom.

A variety of teaching styles was observed across and within each of the three classrooms. Anna, a typically traditional teacher, was observed to also utilize a very constructivist approach to teaching science in one observation. Barbara and Christie, both who tend to be more project-based and group oriented on a regular basis, also employed teacher-driven direct instruction at times. It is a salient note then, that when pedagogical

choices changed within these classrooms, the level of learner interactions often changed as well. When Anna, for example, moved to a group-oriented lesson, the interactions of learners significantly increased as they worked with one another. In the other two classrooms, occasional forays into a direct instruction mode resulted in far less student interaction than was seen in the bulk of the observations.

When activities were teacher-driven, interactions in all three classrooms were observed to be primarily teacher to student and often in the form of question-response. Observational fieldnotes indicated that such lessons were “tightly structured” as students worked independently; discussion between learners was present while the teachers controlled the ebb and flow of the conversation by calling on students, allowing comments, and answering questions. Student to student interactions were also seen throughout the observations as students at times worked in pairs or small groups toward the completion of a common task; such interactions between students were primarily observed to be focused at finding information to complete an assignment, and typically controlled for time and content by the teacher.

During particular group activities, the interactions between all the occupants of the classrooms increased significantly, especially when students were assigned a task that required higher levels of collaboration and communication in order to successfully complete the task at hand – tasks that were often referred to as “fun” by the students in each of the classrooms. It was within these lessons – from the science “button lesson” in Anna’s classroom, to the “centers activities” in Barbara’s classroom, to the “Vietnam project” in Christie’s classroom – that higher levels of engagement and interest in the lesson content were consistently observed in addition to increased interaction as learners

interacted with the content and each other. These lessons, both when technology was present and when it was not, were structured in such a way as to reflect a constructivist orientation. Lessons of this orientation were often presented as a project students worked on collaboratively as they searched for solutions, and as such were increasingly student-centered with teachers taking a facilitative role in the process. This pedagogical approach, often referred to as *problem-based learning* (PBL), provided opportunities to acquire critical knowledge while increasing the learners' proficiency in problem solving and collaboration (Maricopa Center for Learning & Instruction, 2001).

Seminal writers of constructivist learning theory thoroughly portrayed the responsibility of teachers and how their pedagogical choices could impact the quality of student learning. Dewey (1933) noted that students are themselves responsible for the initiative required to learn, as the teacher – or facilitator – “steers the boat” (p. 36), while experiences that captivate the learner engage them in deeper levels of understanding. When approaching instruction with higher levels of activity and interaction with others within student-centered learning experiences, teachers assist students in respecting their own powers of thinking and analysis through the natural curiosity inherent in children (Bruner, 1961). Others, noted earlier in this document (Ausubel, 1968; Piaget, 1983; Vygotsky, 1978), echoed the sentiments expressed above – pedagogical techniques that deeply engage the learner result in better understanding and prepare them for learning that will occur throughout their lifetime.

This study did not look at the measurement of various levels of student academic achievement per se, but nonetheless from the data presented it could be inferred that as students engage at higher levels with content, with each other, and with their teacher,

their level of understanding and academic performance will increase. Within the context of this research it was apparent that these phenomena do not happen in isolation or accidentally, which led to the conclusion that teachers dramatically control the interaction of learners – with content and with one another – by the pedagogical choices they employ in their classrooms. Additionally, it can be concluded that when teachers utilize student-centered problem and project-based activities within their classroom instruction, motivation, engagement, and learner interactions significantly increase.

#### *Learner Interactions and Educational Technology*

The use of educational technology varied significantly across and within the three case studies throughout the research project. The findings noted that students often “worked independently” on assignments involving available technology – whether on individual desktop, handheld, or laptop computers. It was during these activities that learner interactions were often seen to be minimal and reflective of the individual teacher’s preference for students visiting while they worked on particular assignments. In a loosely structured classroom, for example, students were observed to regularly visit with one another while they worked. While in a more tightly structured classroom, however, student interaction was limited based on the teacher’s proclivity to control the classroom climate while students worked individually.

This weaving of technology into traditional teaching practice was classified by Dwyer, Ringstaff, and Sandholtz (1990a) as the “adoption” level of technology integration, and the beginning of an evolutionary process teachers move through as they learn to incorporate higher levels of technology integration into their teaching (Dwyer, 1994). The use of technology to support traditional practice allows an initial level of

comfort for teachers and students and often leads to more constructivist approaches of teaching and learning as the evolution continues (Vahey & Crawford, 2002). The three teachers in this study, while at different places on this evolutionary continuum, were all observed to use technology within traditional learning environments during the research, in the course of which learner interactions were often minimal. Given the data collected throughout the observations and the support of earlier research, it was concluded that when technology is utilized to support traditional modes of instruction, learner interactions are not significantly different from lessons devoid of technology and are directly related to individual teachers' teaching styles and expectations as students work independently.

In addition to the lesson types described above, data also indicated that students were often more engaged in the learning process and actively pursuing the completion of a required task within these traditionally structured lessons. This resulted at times in a "buzz of noise" as students worked individually on their assignments and were allowed to occasionally collaborate with one another for troubleshooting, formatting, or sharing their learning. This even occurred in Anna's classroom to some extent as a result of her allowing students to assist one another with instructional tools that challenged her knowledge and expertise. The use of laptops had been observed in the literature to often result in more focused individual work (Russell et al., 2004) while also increasing collaboration between learners (Rockman *ET AL*, 1998), and the use of technology in general was observed to even positively contribute to a school's social environment (Wenglinsky, 1998). Students in this study explained their engagement in technology related tasks as resulting from the use of technology making learning "more fun," "more

interesting,” and “hands on,” even when employed as a technological application of a traditional tool, e.g. an electronic reading basal or encyclopedia. In light of the data and findings from this study, it was concluded that the use of educational technology, even when directed toward independent tasks, results in increased student motivation and engagement in the learning process.

Also found within the three case studies were a number of lessons involving technology that resulted in more intense levels of interaction. Students were observed helping one another on many occasions and often collaborating on a specific task. While the lesson content did not appear significantly different than those observations discussed above, constructivist oriented pedagogical choices made by the teachers appeared to open the door to increased levels of interaction. Such choices often resulted in students becoming teachers in a sense – gathering information, teaching one another, and sharing their knowledge of technological applications and curriculum content.

As found in previous research, the students in this study often served as resources for their peers throughout the observations as they had particular knowledge that they could share (Rockman, 2003), and such events occurred with students across a wide range of ability levels (Bebell, 2005). The collaboration that emerged while students interacted with technology also contributed to increased communication between students and with their teachers. Students indicated a benefit from helping one another and at times helping their teachers learn something new, while also noting that they were getting to know one another better while working with educational technology. The teachers also referenced these events, as students “learn to respect one another,” and that they find “a lot more collaboration” when students are working with educational technology. A key

difference between these observations and the independently focused technology lessons was the teacher's decision to instruct students in a group-oriented, collaborative setting. As a result of these findings, it was concluded that the integration of educational technology into the teaching and learning process contributes to increased communication and collaboration among learners when students are allowed to work with one another toward a common goal.

In each of the classrooms, occurrences were also observed where students stepped to the forefront of the teaching process, in effect taking over the teaching process as the teacher stepped aside. One student described this phenomenon as the teacher getting "kicked off" as students "take over." These moments occurred as teachers ventured into lesson presentations that were grounded in constructivist concepts – where students take control of their own learning as teachers guide and facilitate the learning process that occurs naturally – and were often accompanied by higher levels of critical thinking and analysis than observed in other more traditional lessons. Of particular note in two of the classrooms were students who often struggled academically; during technology-rich lessons these students were observed to engage at higher levels and assist in the teaching process as they found a medium that leveled their ability with that of their peers.

The use of such occasional constructivist pedagogy occurred in all three classrooms, notably both when technology was present and when it was not. This observation challenged an initial research assumption that the integration of technology into instruction would naturally lead to more constructivist learning experiences in the classrooms under study. An important caveat to consider, however, is that these experiences were observed more often when technology was in use and when students

were allowed considerable freedom in the design and direction of their own learning. When teachers purposefully engaged in constructivist teaching and learning activities and utilized educational technology as a tool within these lessons, students were observed to readily embrace a teaching role as their teachers allowed them to have more control of the learning process. After observing these classrooms and analyzing the data collected throughout the research process, it was concluded that while constructivist teaching and learning are not dependent on technology – or an immediate outgrowth of its use – educational technology provides a learner-centered pedagogical tool that can significantly contribute to meaningful constructivist practice when thoughtfully integrated into instruction.

#### *Learner Perceptions of Educational Technology's Impact on Learning*

Throughout the research process, and across all three classrooms, higher levels of engagement and interest in the learning process were consistently noted during observations that utilized educational technology. This factor was repeatedly observed throughout the technology research, whether dated (e.g. Idaho Council for Technology in Learning, 1999; Ringstaff et al., 1996) or more recent (e.g. Russell et al., 2004; Zucker & McGhee, 2005). In order to better understand the relationship between technology and student interest, research participants were asked how they perceived technology impacting their teaching or learning.

Students consistently noted that learning with technology was “more fun” and that it “helps us learn,” while also suggesting that they more thoroughly learn lesson content when technology is used within the learning process. Teachers also noted the increased level of student interest and enjoyment in learning when technology was utilized, and two



of the three teachers indicated a desire to incorporate more technology into their daily instruction; Christie and her students both indicated they had perhaps reached a saturation point with technology and did not believe that they could or should use technology any more than their current level of integration.

The changes in learner interactions and interest were nowhere more evident than in Anna's classroom, as she purposefully worked to bring more technology into her traditional practice. Anna reflected that students "want more technology" and would "prefer to manage their own learning," while also admitting that students may not "enjoy a classroom where there are no computers." A truly remarkable difference in learner interactions was observed in this classroom between the structured, teacher-centered lessons and those that moved to a student-centered focus with educational technology providing an avenue for students to engage with their teacher and one another during the learning process. As a result of these discussions and findings from the data, it was concluded that the purposeful integration of educational technology provides a source of interest and motivation for students that can result in deeper engagement in the learning process and significant interactions of classroom inhabitants.

#### *Observer Effect on the Research*

The qualitative study reported in this document was conducted in a school where the researcher simultaneously served as researcher and school principal, and thus was the direct supervisor of the research participants. Classroom teachers were selected for the project purposefully due to their varied experience and use of educational technology, but also because the researcher perceived a level of trust between the researcher and the

researched that would facilitate the collection of deep, rich data and not unduly influence or impact the findings of the study.

The research was conducted as openly as possible, and all participants of the study were informed of the nature and purpose of the research prior to indicating their consent to participate. Throughout the data collection process the researcher was identified by the use of a large nametag, although this appeared to have little impact on the student participants as they primarily interacted with the researcher in his role as school principal.

While attempting to conduct the research with as little disruption or impact as possible, the researcher was aware that he was significantly increasing his level of interaction within these classrooms. A potential stress on the adult participants could have resulted as he regularly invaded what Anderson, Herr, and Nihlen (1994) referred to as the “fishbowl” (p. 40) that teachers inhabit under the scrutiny of outsiders – including principals. Although teachers consistently indicated comfort and trust in their dealings with the researcher, power and gender relationships could have potentially impacted the research (Møller, 1998; Paisley, 1994).

During the interview process, the researcher-supervisor dichotomy was explored with the participants. They indicated consistently that this dual role had a negligible impact on their day-to-day activities and viewed the researcher’s presence in a positive manner, with no indication of power or gender issues emerging through the data. Teachers made statements to the effect of “I respect you as a principal,” “we were all comfortable,” and “it didn’t bother me at all.” All three teachers reflected on a level of trust that had been established with the researcher, and that they interpreted his presence

in their classrooms as “a person who wants to make things better,” who was “here to help,” and who did not impact the delivery of instruction “at all.”

Students interviewed from all three classrooms referenced certain students they perceived to act differently while the researcher was present, including improved behavior or acting like they knew “what was going on,” although the teachers all interpreted these observations as isolated events and not significantly different from how students acted on a regular basis. The students also indicated a positive response from the research activities and a level of trust with the researcher, as they “felt comfortable,” and perceived the researcher as “another teacher” in the classroom who was “helpful to us.”

Teacher and student participants consistently displayed a high level of comfort and trust with the researcher throughout the study, and relationships with teachers deepened as a result of the increased time observing, talking about the research, visiting about students, and reflecting together over personal and professional issues over the course of the journey. In view of the findings presented earlier and the relationships that strengthened during the process, it was concluded that the researcher-supervisor dichotomy had little impact on the outcome of the research on learner interactions due to a significant level of trust and comfort between the researcher and participants.

An additional role inhabited by the researcher did in fact impact the research. As a regular visitor to the classrooms for over a year, the researcher had become known as a technology expert who often assisted students and teachers with the use of technological resources and troubleshooting of hardware issues. This practice continued in the new role of participant observer as the research commenced and continued throughout the study, and was not markedly different than the pre-research context other than increased contact

time due to the research schedule. In terms of Anna's class, however, the teacher used her participation in the research project as a personal motivation to begin integrating technology into her classroom – a decision that allowed the researcher an opportunity for a number of teachable moments as he sought to help her enhance her pedagogical practice at her request.

In light of this factor, it could be argued that the observer (or Hawthorne) effect in this research unnecessarily altered the research context by changing the natural environment, and that the researcher's social construction and biases could have impacted the outcomes of the study (Carpenter, 1999). However, it could also be claimed that such an event served to strengthen the research, as the researcher was able to observe an evolution occurring as Anna pursued her desire to grow professionally and strengthen her teaching practice. It was thus concluded that, while the research did indeed change the environment in one of the classrooms, the data indicate that when appropriate support and encouragement are provided in a climate of mutual trust and respect – and perceived as helpful and non-threatening – teachers are open to learning new skills that will serve to enhance their pedagogy and be meaningful to students.

The research began with the knowledge that these two competing roles might be difficult to distinguish by the participants while being rather clear-cut to the researcher. Instances in all three classrooms occurred, however, where the researcher initially struggled with observing teachers and students through a different lens than that which he was accustomed to. A period of adjustment was required as the researcher periodically refocused observations on the purpose of the study, and such deviations lessened as the research progressed and the researcher openly reflected on such occurrences. It was also

noted that one or two other inhabitants of the school – from outside the research process – questioned the time spent with particular classrooms and the researcher being focused on this project to the potential detriment of the school. This perception was not anticipated, and thus the rest of the school staff had not been formally informed of the details of this project. In a post-data collection staff meeting, the research process and district/university support of the work was reviewed, which allayed the majority of issues presented by a minority of faculty. As a reflection of these experiences throughout the research project, it was also concluded that research conducted by a school administrator in their own school is entirely possible and potentially beneficial; full, honest, and open communication about the research should occur early and often with all adult inhabitants (even with those not involved) to avoid misconceptions that could negatively impact research outcomes.

### *Summary of Conclusions*

A discussion of the findings from across the three case studies has been presented in the previous pages, which in turn led to a number of conclusions offered from this qualitative research project. Said conclusions are offered in summary below:

1. There is a definitive connection between each teacher's guiding philosophy and beliefs and the pedagogical tools they employ in the delivery of instruction to their students. Significant to this connection is that when a new tool or method of instruction is introduced and perceived as contrary to their guiding philosophy, adoption of such a device is difficult to embrace.

2. The guiding beliefs of teachers have a significant impact on how students interact with their teacher and one another during the learning process.
3. Elementary students are definitively cognizant of how their teachers present instructional material, and readily accept their teachers as experts and methods of teaching as the “right way.”
4. In order for teachers to make substantial and meaningful use of the technological tools at their disposal, while at the same time adjusting or changing their pedagogical approaches, opportunities to subsume new learning into previous knowledge must be consistently provided in a manner that differentiates instruction to meet the needs of individual teachers.
5. Teachers benefit significantly from involvement in activities that challenge them to look deeply at their own practice and to be active learners as they dare to incorporate these new practices into their classrooms.
6. Increased interactions between students and teachers, particularly as teachers give away control to their students and learn along with them and from them, contribute to a more collaborative environment where all inhabitants of the classroom learn from each other.
7. Teachers dramatically control the interaction of learners – with content and with one another – by the pedagogical choices they employ in their classrooms.

8. When teachers utilize student-centered problem and project-based activities within their classroom instruction, motivation, engagement, and learner interactions significantly increase.
9. When technology is utilized to support traditional modes of instruction, learner interactions are not significantly different from lessons devoid of technology and are directly related to individual teachers' teaching styles and expectations as students work independently.
10. The use of educational technology, even when directed toward independent tasks, results in increased student motivation and engagement in the learning process.
11. The integration of educational technology into the teaching and learning process contributes to increased communication and collaboration among learners when students are allowed to work with one another toward a common goal.
12. While constructivist teaching and learning are not dependent on technology – or an immediate outgrowth of its use – educational technology provides a learner-centered pedagogical tool that can significantly contribute to meaningful constructivist practice when thoughtfully integrated into instruction.
13. The purposeful integration of educational technology provides a source of interest and motivation for students that can result in deeper engagement in the learning process and significant interactions of classroom inhabitants.

14. The researcher-supervisor dichotomy had little impact on the outcome of the research on learner interactions due to a significant level of trust and comfort between the researcher and participants.
15. When appropriate support and encouragement are provided in a climate of mutual trust and respect – and perceived as helpful and non-threatening – teachers are open to learning new skills that will serve to enhance their pedagogy and be meaningful to students.
16. Research conducted by a school administrator in their own school is entirely possible and potentially beneficial; full, honest, and open communication about the research should occur early and often with all adult inhabitants (even with those not involved) to avoid misconceptions that could negatively impact research outcomes.

#### *Implications of the Research*

A discussion of the findings and conclusions of the research has been presented in the previous pages of this chapter, and the focus of this final section of the report turns to implications that can be made as the conclusions of this research are applied to current and future educational practice. While not exhaustive in nature and open to interpretation by the reader, these implications are presented with the intent that they will provoke additional discussion and debate by the educational community as educators seek to improve the educational climate of 21<sup>st</sup> Century classrooms, and as researchers consider the possibility of further exploration of these issues.

This research was conducted to investigate the impact educational technology exerts on how learners interact with one another in elementary classrooms. Technology



does indeed have a role to play in the education of 21<sup>st</sup> Century learners, and most decidedly provides a vehicle for increased learner interaction, student-centered learning, and the increased motivation and engagement of students. These benefits, however, do not just magically happen as educational technology is introduced into today's classrooms.

In reviewing the findings and conclusions, one thing became readily apparent – the individual teacher controls what content is presented, how it is presented, how students interact with one another, and what tools are used to assist students in learning. In other words, teachers significantly matter! Research reviewed for this study continues to indicate that certain pedagogical choices (e.g. learner-centered and project-based teaching) may result in higher levels of student engagement and achievement. Said research also indicates, however, that teachers will likely teach the way they were taught or in the manner in which they themselves learn best; the three teachers featured in this study confirmed this conclusion. To change teachers' pedagogical beliefs and practices is to ask them to change their very core, which is a difficult journey when such practices run contrary to their deeply held beliefs. Providing opportunities to learn more deeply about teaching and learning styles while supporting the experimentation of instructional changes is a significant implication of this study for practicing school administrators.

The interactions of learners – both teachers and students – were the primary focus of this research, primarily in what impact educational technology played in such interactions. The results of the study clearly indicated that, when utilized in lessons with a constructivist orientation, a higher level of interaction was observed. Whether the technology influenced the pedagogical choice or the pedagogical choice allowed higher

levels of interaction when technology was used as an instructional tool was not fully delineated. However, in that more interaction in the learning environment was observed when both factors were present, a connection between the two factors clearly exists. As schools seek to expand their use of educational technology, serious attention should be given to supporting pedagogical approaches that can significantly enhance the benefit of these tools.

The researcher, as a practicing 21<sup>st</sup> Century school administrator, has aggressively pursued the purchase and installation of significant technological resources, often assuming that teachers will “take up the torch” and learn how to utilize the resources at their disposal. While serious consideration has been provided to the acquisition of these resources, little has been given to considering the impact such resources would have on individual teachers. A range of reaction to the availability of technology has been observed in this school as some teachers have embraced the technology while others have attempted to utilize it in rather traditional applications, and some have all but avoided bringing it into their classrooms. Although some attempts to train teachers in the use of these tools have occurred, teachers have primarily been left on their own to use, experiment, and learn while at the same time continuing their daily duties of educating the next generation.

A salient and serious implication of this study, then, is that practicing school administrators must make a tremendous effort to provide appropriate and differentiated professional development if true change in instructional practice is expected to occur. The teacher in the third case study, who had been in the field only five years, had experienced no more college coursework in technology integration than the teachers who

had graduated two decades before. Even though teacher preparation programs may have changed in the past few years and likely will continue to be modified based on current opportunities, the fact remains that schools are filled with teachers who will be “on the job” for 10, 20, even 30 years hence. It is incumbent upon schools and districts to not rely upon osmosis to transform Industrial Age classrooms into Digital Age classrooms (The George Lucas Educational Foundation, 2002). Significant and continuing professional development – both in the use of educational technology and in learning theory – must occur for change of this magnitude to take place.

Related to the implication of increasing professional development opportunities for teachers was an unexpected finding that the research project itself provided a significant learning opportunity for the researcher and teachers as they participated in the study. The research project provided a number of conversations about teaching and learning that went far beyond the norm in this elementary school setting, and the adult participants found the reflective process to be of benefit to their personal understanding of their philosophical and pedagogical preferences while encouraging them to improve their practice. Thus an equally unexpected implication of this research is that school professionals should seriously consider school based research of this type to achieve positive change in schools and individual teachers’ professional learning.

As in the case of the researcher and teachers having the opportunity to grow professionally from the increased dialogue and understanding of the research focus, the teachers involved in the study benefited as well from the opportunity to understand how their students perceived their teaching, their classrooms, and their relationships with students. While this study provided information via a confidential focus group interview

on a limited topic, it is certainly a possibility that elementary students, when provided an opportunity to provide their teacher with reflective feedback, will rise to the occasion and offer unusual insight into the world of students and their perceptions of their classrooms. This study should serve as an encouragement to teachers to actively engage students in the process of reflective feedback – a process that will assist in improving instruction as well as deepening a sense of community in classrooms as teachers truly listen to the voices of their students.

An additional caveat to this research came as the researcher found deeper and more trusting relationships with teachers developing through this shared experience. During the data collection period a number of administrative tasks were set aside in order to open up additional time for classroom observations, and the result of this increased time and the non-evaluative focus of the research led to a much greater appreciation and understanding for what these teachers do every day. This depth of relationship does not yet exist with all of the members of the school culture, but the researcher has been encouraged by the research to continue building stronger relationships with others. This is not an easy task, particularly when administrative assignments often change every few years, but a renewed focus for this practicing administrator is “relationships matter.” As students typically respond to teachers with whom they connect on a personal level, so much more likely will teachers respond to the leadership of an administrator with whom *they* connect on a personal level. The likelihood of positive experiences occurring for students is much enhanced when professional educators work in an environment of mutual trust and respect for one another.

At the beginning of this dissertation is found an epigraph taken from a book by psychologist Jerome S. Bruner that reads, “The rate of change in the society in which we live forces us to redefine how we shall educate a new generation” (1966, p. 22). Bruner added a caution in this work, in that “education will require constant redefinition...the period ahead may involve such a rapid rate of change in specific technology that narrow skills will become obsolete within a reasonably short time after their acquisition” (p. 32). These sentiments, written forty years ago in response to the difficulties facing schools in a significantly different time, are highly applicable for schools and educators facing the education of students in the Digital Age. Schools are still faced with the rapid change Bruner spoke of, as well as said difficulties inherent in redefining education given the needs of the current generation. It is the desire of the researcher that this study will assist the education community in better understanding the needs of 21<sup>st</sup> Century schools as we embrace the challenges of today and look forward to those that still lie ahead.

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## APPENDICES

*Appendix A – Adult Consent Form*



WICHITA STATE UNIVERSITY  
*Department of Educational Leadership*

September 2005

Dear Research Participant,

As a requirement of the completion of my Doctor of Education degree in Educational Leadership, I have proposed a study to investigate the changes that occur in interactions in the learning environment due to the presence and use of instructional technology. Participants have been selected based upon a variety of teaching styles and perceived levels of technology integration. Your participation will consist of a series of formal classroom observations in which I will observe the interactions in the learning environment of your classroom. Each formal observation will last approximately 90 minutes in length. Additionally, a number of informal walk-through observations will be completed weekly throughout the data collection process. Finally, I will ask you to participate in a personal interview that will last no longer than 60 minutes and will be held at a time and in a location that is mutually convenient. The results of this study will assist me in discovering what changes in learner interactions occur when technology is utilized within the learning environment. There is no intent to use these data in any way that can be construed to be an evaluation of your teaching behavior. This study is a descriptive study only. Findings from this research may be presented at regional, national, or international conferences and may result in publication in scholarly journals.

Your interview responses will remain confidential and you will not be personally identified in the final report. With your agreement, the interview will be tape recorded to assist me in accurately describing your responses; recordings will be maintained through the completion of the project and then erased. To insure accuracy, I will summarize your responses at the conclusion of your interview and provide you with the opportunity to edit or correct any misinterpretations or misunderstandings.

Participation in this study is entirely voluntary and you are under no obligation to participate. Your decision not to participate will not affect your future relations with the researcher, school district, or university. If you have questions please contact me at (316) 973-0650 or [rmiller@usd259.net](mailto:rmiller@usd259.net). Dr. Ian Gibson, dissertation advisor, at [ian.gibson@wichita.edu](mailto:ian.gibson@wichita.edu), or the Department of Educational Leadership at (316) 978-3325. If you have any questions pertaining to your rights as a research participant, you can contact the Office of Research Administration at Wichita State University, Wichita, Kansas, 67260-0007, telephone (316) 978-3285.

By signing one copy of this form you are granting your permission to participate in the proposed observations and interview. You are welcome to keep a copy of the form. Your signature indicates that you have read the information provided above and voluntarily agree to participate in the study. You may also withdraw from the study at any time prior to March 15, 2006, without penalty or fear of reprisal. Thank you for assisting me in this important study.

Sincerely,

Russell K. Miller  
WSU Doctoral Student

I consent to the aforementioned classroom observations and personal interview.

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Participant Signature

Date

Appendix B – Parent Consent/Student Assent Form



WICHITA STATE UNIVERSITY  
Department of Educational Leadership

September 2005

Dear Research Participant and Parent/Legal Guardian:

As a requirement of the completion of my Doctor of Education degree in Educational Leadership, I have proposed a study to investigate the changes that occur in interactions in the learning environment due to the presence and use of instructional technology. Classrooms have been selected based upon a variety of teaching styles and perceived levels of technology integration. Your participation will consist of a series of formal classroom observations in which I will observe the interactions in the learning environment of your classroom. Each formal observation will last approximately 90 minutes in length. Additionally, a number of informal walk-through observations will be completed weekly throughout the data collection process. Further, I will ask selected groups of students to participate in a focus group interview that will last no longer than 60 minutes and will be held at a time and in a location that is mutually convenient. The results of this study will assist me in discovering what changes in learner interactions occur when technology is utilized within the learning environment. Findings from this research may be presented at regional, national, or international conferences and may result in publication in scholarly journals.

In order for you to participate in a focus group interview, it is necessary to gain your consent for the interview and the approval of your parent/legal guardian. I would greatly appreciate your involvement in the research in order to incorporate your unique perspective on the topic. Your interview responses will remain confidential and you will not be personally identified in the final report. With your agreement, the interviews will be tape recorded to assist me in accurately describing responses; recordings will be maintained through the completion of the project and then erased. To insure accuracy, I will summarize participant responses at the conclusion of the interview and provide the opportunity to edit or correct any misunderstandings or misinterpretations.

Participation in this study is entirely voluntary and students are under no obligation to participate. Your decision not to participate will not affect your future relations with the school, district or university. If you have questions please contact me at (316) 973-0650 or [rmiller@usd259.net](mailto:rmiller@usd259.net), Dr. Ian Gibson, dissertation advisor, at [ian.gibson@wichita.edu](mailto:ian.gibson@wichita.edu), or the Department of Educational Leadership at (316) 978-3325. If you have any questions pertaining to your rights as a research participant, you can contact the Office of Research Administration at Wichita State University, Wichita, Kansas, 67260-0007, telephone (316) 978-3285.

By signing one copy of this form, permission is being granted for a minor student to participate in this study. The student signature indicates that you have read the information provided above and voluntarily agree to participate in the study. You are welcome to keep a copy of the form. You may also withdraw from the study at any time without penalty or fear of reprisal. Thank you for assisting me in this important study.

Sincerely,

Russell K. Miller  
WSU Doctoral Student

- I consent to my child participating in classroom observations related to the WSU research study.
- I consent to my child participating in a focus group interview related to the WSU research study.

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Parent/Guardian Signature Date

- I assent to participating in classroom observations related to the WSU research study.
- I assent to participating in a focus group interview related to the WSU research study

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Student Signature Date

*Appendix C – Personal Interview Protocol*

**Dissertation Interview Protocol, December 2005**

As you know, I have been conducting research this fall related to my completion of a Doctorate of Education degree from Wichita State University. This research project has focused on the interactions between students and teachers in your classroom, particularly in reference to any impact educational technology is having on those interactions.

You were selected because of your ability and willingness to not only allow this research to take place in your classroom but also to provide information about the research topic based on your own personal and professional experiences to date. I want you to feel free to share your opinions regarding this topic, being mindful that there is no specific right or wrong answer to any of the questions. Please keep in mind that I am interested in all comments whether they are positive or negative, and that your honest responses will serve to insure that this research is accurate and truly reflective of your perspective.

Before we begin, I would like to share a few procedures for this conversation. Although we will be on a first name basis today, no names will be used when I report the results of the study. You can be assured of complete confidentiality. With your permission, I would like to digitally record our session today so that I will be able to more carefully listen to your ideas later. The recording will only be used for the purpose of note taking and will be destroyed following the completion of the study. Participation in this study is entirely voluntary, for which you consented earlier this year. I would ask that you reconfirm your consent at this time.



This session should last between 45 and 60 minutes. Do you have any questions about the research process prior to our interview beginning?

1. I'd like to hear a little about your educational background. How many years have you been teaching? Where did you receive your degree, and what was the focus? What advanced degrees have you earned or are pursuing at the present time?
2. How would you summarize your personal philosophy about teaching? How has your philosophy changed over the years you have been teaching?
3. As you consider your day-to-day decisions regarding the delivery of instruction in your classroom, what would you describe to be your preferred approach to teaching? Why? How do you feel students learn best in your classroom? Describe the way you involve students in classroom activities.
4. Think for a moment about the predominant learning relationships in your classroom. How do students typically interact with one another while involved in the learning process in your classroom? How do they typically interact with you in your classroom?
5. In your opinion, what role should educational technology play in elementary classrooms? What role do you see it play in your classroom?
6. [Interviewees were asked to consider these four questions prior to the interview taking place] How would you describe your educational technology skills? What training in the use of educational technology have you experienced? What would you say is your prevailing attitude toward technology in your classroom? David C. Dwyer proposed the following 'levels of adoption' of technology integration while working with the Apple Classrooms of Tomorrow (ACOT) project in the early 1990s. Where would you rate yourself on the 'levels of adoption?'

**Entry.** *Learn the basics of using the new technology.*

**Adoption.** *Use new technology to support traditional instruction.*

**Adaptation.** *Integrate new technology into traditional classroom practice. Here, they often focus on increased student productivity and engagement by using word processors, spreadsheets, and graphics tools.*

**Appropriation.** *Focus on cooperative, project-based, and interdisciplinary work—incorporating the technology as needed and as one of many tools.*

**Invention.** *Discover new uses for technology tools, for example, developing spreadsheet macros for teaching algebra or designing projects that combine multiple technologies.*

7. Describe why you placed yourself at the \_\_\_\_\_ level of adoption.
8. How has your teaching practice changed from before you began to integrate technology into your lessons? Do you see these changes as significant to the outcomes of your teaching? How so?
9. In what ways do you think the integration of technology in your classroom has influenced interactions between students and between you and your students? What impact, if any, should technology have on the way students interact with you and one another?
10. Do you need to do further technology integration in your classroom? Why or why not? What additional tools or professional development do you need in order to accomplish this?
11. How do you envision your teaching and educational philosophy three to five years from now?
12. As I have conducted research in your classroom, I have been in and out of the room many times, taking notes, and interacting with your students. My presence as researcher and principal was perhaps somewhat blurred during this time frame, even though you were aware of the process I was involved in. Describe how you felt about me conducting this research in your classroom over the past months. How did the dual role of principal and researcher influence your day-to-day decisions? What differences did you observe in how students interacted while I was present as compared to other times during the day? How did my supervisory role impact your mode of delivering instruction?
13. As we conclude our interview, can you think of anything else I need to know about this topic or the research process?

*Appendix D – Student Focus Group Protocol*

**Dissertation Focus Group Protocol, December 2005**

In addition to my job of being your principal this year, I also have been conducting research this fall as a part of classes I am taking at Wichita State University. My research project has been looking at relationships between students and teachers in your classroom, and how using technology in your classroom might be changing those relationships.

You were selected for this group interview because of your ability to speak about and share your opinions about this topic. I want you to feel free to share your opinions about this topic, being mindful that there is no specific right or wrong answer to any of the questions, and that I am interested in all comments whether they are positive or negative.

Before we begin, I would like to share a few procedures for this conversation. Although we will be on a first name basis today, no names will be used when I report the results of the study. You can be assured of complete confidentiality. With your permission, I would like to digitally record our session today so that I will be able to more carefully listen to your ideas later. The recording will only be used for the purpose of note taking and will be destroyed following the completion of the study. Participation in this study is entirely voluntary, for which you and your parents consented earlier this year. I would ask that you reconfirm your consent at this time.

This interview should last between 45 and 60 minutes. Do you have any questions about the research process prior to our interview beginning?

1. Your teacher uses a variety of methods to teach you in your classroom. How would you describe your teacher's favorite way of teaching? How do you feel students learn best in your classroom? Describe the way students are involved in classroom activities.
2. Think for a moment about relationships between the people in your classroom. How do students typically interact with or relate to one another during instruction in your classroom? How do students typically interact or relate with the teacher in your classroom?
3. We have lots of different types of technology in our school, like Palms, projectors, laptops, etc. How do you see technology being used in your classroom? What other ways do you think it should be used?
4. How has your learning changed from before you began to use technology in your classroom?
5. In what ways do you think using technology in your classroom has influenced interactions or relationships between students? What about your interactions or relationships with your teacher?
6. Do you need to use technology more in your classroom? Why or why not?
7. As I have conducted research in your classroom, I have been in and out of the room many times, taking notes, and interacting with students. Describe how you felt about me conducting this research in your classroom over the past months. What differences did you observe in how students interacted while I was present as compared to other times during the day? How did my presence impact your teacher's teaching?
8. As we conclude our interview, can you think of anything else I need to know about this topic or the research process?